The Dock and Harbour Authority

No. 313. Vol. XXVII. NOVEMBER, 1946

CONTENTS

Editorial Comments

The Port of Mombasa.

The island of Mombasa, lying off the mainland of the Kenya Protectorate, is connected therewith by the Nyali Bridge and the Macupa Causeway. Situated 150 miles North of Zanzibar, it lies in the middle of a double inlet of the sea, stretching northward into Port Tudor and westward into Port Reitz.

The port has two harbours; Mombasa, situated on the east, and Kilindini at the west end of the island. Mombasa is a safe harbour with sufficient water for vessels of 30-ft. draft, but is now used only for native craft. This trade comprises both the small coastal dhows, and also the larger dhows which cross over from the Persian Gulf, arriving on the N.E. Monsoon and returning on the S.W. Monsoon.

The larger and modern harbour of Kilindini is the finest sheltered harbour on the east coast of Africa. It is interesting to note that the name Kilindini signifies " Beside the Deep Place," the water deepening at once to 100-ft. and over, so that the whole area is suitable for shipping of any size and draft. Also the shoreline at Kilindini has been favourably aligned by nature to facilitate large scale harbour works, and if, in years to come, the present port facilities should prove inadequate, additional berths with deep water alongside can be constructed without leaving the island shore of the harbour.

The Kenya and Uganda Railways and Harbours Administration, to whom we are indebted for the article appearing elsewhere in this issue have already carried out extensive port improvements, and they are fortunate in the knowledge that any expansion of trade in the vast East African hinterland served by the Port of Mombasa, can be adequately dealt with at any time by a corresponding increase in shipping and cargo handling facilities.

The Dock Labour Decasualisation Problem.

The announcement on the 1st October last by the Ministry of Labour and National Service, that the National Joint Council for the Port Transport Industry have notified the Minister of Labour and National Service that they have been unable to agree upon the formulation of a scheme of decasualisation for submission to him under the provisions of the Dock Workers (Regulation of Employment) Act, 1946, is a regrettable culmination of the negotiations between the employers' organisations and the trade unions' representatives, which have been in progress for some months past.

Having been officially notified of the deadlock, the Minister, in pursuance of the powers vested in him by the Act, has appointed Sir John Forster, K.C., to make such enquiries as he may consider necessary, and, in particular, to enquire into the differences existing between the two sides of the Joint Council.

The main points of contention have already been discussed in these columns, particularly in our September issue, and a reiteration of the arguments put forward would be superfluous.

There is no question that it will be exceedingly difficult to arrive at a satisfactory solution of the problem, but it is essential that a scheme should be put into operation at the earliest possible moment. It is true that the Minister has until 1st July, 1947, in which to prepare a plan and carry it into effect, but meantime, there is the immediate problem of stemming the rising costs in the industry. The retention of redundant men on the port registers means higher contributions have to be paid by the employers to the management funds of the National Dock Labour Corporation or the Minister of Transport, and this cost can only be passed on to the merchant and the consumer in the form of higher port handling costs.

Another factor to be considered is the maldistribution of labour. On the one hand, complaints are heard from some ports—among them Hull and the Tee-side—that there is an acute shortage of dock labour, and, at the same time, reports are received of a redundancy of dockers at the Welsh ports and the Clyde. The position is complicated by the fact that shipping demands fluctuate, and conflicting reports are received from day to day, but a recent enquiry has proved that overall there is a heavy surplus of labour available.

The scheme to alleviate shipping delays as far as possible, by transferring dockers from one port to another when occasion demands, even if practicable, cannot be regarded as entirely satisfactory. In some cases the dockers show an understandable reluctance to undertake long distance transfer and, at times, an equal reluctance is shown on the part of the port receiving them. Whether or not diversion of shipping would help to solve this problem is another controversial point.

It is understood that the General Council of British Shipping have written to the Minister of Transport suggesting the principles upon which dock schemes should be based, so as to render them efficient and solvent. We wish every success to these and any other proposals, and it is to be hoped that a speedy solution to the problem will be found.

Editorial Comments—continued

The Fate of Hamburg.

For many years the premier port on the Continent of Europe, having since 1895 outdistanced in shipping traffic its competitors, Antwerp and Marseilles, Hamburg has now incurred the fate assigned in Holy Writ to Capernaum, "exalted to heaven and brought down to hell." With a long record of commercial success dating back to the days of the mediæval Hanseatic League, the port had in the past a world-wide reputation not only for trade and commerce, but also for shipbuilding and naval construction. Now it lies in a ruinous condition due to repeated bombing attacks, especially those of 1943. But more catastrophic than this is the decision of the Allied Powers that it shall not be allowed to recover, as it did after the 1914-18 war, its former capacity for war-making. The production of arms, munitions and implements of war "as well as all types of aircraft and sea-going ships" is prohibited by the Potsdam Decree. Accordingly the great dock installations and slipways on the premises of Blohm and Voss have been, and are being, demolished and the site, if it does not in future lie idle and untenanted, will have to be devoted to other and less pernicious pursuits.

Yet the eclipse may not be complete. The startling and phenomenal recovery made by the port after the last war indicates a degree of enterprise and energy on the part of the inhabitants which may again exhibit itself in unexpected, though natural, directions. In the valley of the Elbe and the region of Westphalia, Hamburg has a vast productive hinterland which may yet serve to restore its prestige and rehabilitate its fortunes. Indeed, the present controlling authorities may come to see that it is not a wise and economic policy to deprive Germany to too great an extent of the support which it has received in the past from overseas trade. In some minor degree Hamburg may continue to flourish to the benefit of Germany and Western Europe.

Meanwhile, it is reported that repair work at the port is well in hand and that shipping berths for coasting steamers, storage facilities, oil tanks and their supply pipes, as well as grain silos and elevators are continuously being brought into use. To the restoration of such peaceful commercial agencies there can be no objection.

Government Review of South Wales Ports.

The first of a series of annual papers on the state of trade in Wales and Monmouthshire has recently been issued by H.M. Stationery Office. The period covered is the first post-war year to August last, and among the details given is a statement showing the total trade at the six principal ports in South Wales.

Comparative figures show that, before the war, the traffic handled at the ports consisted mainly of coal for export, and it is this trade which shows the most serious decline. There has also been a decline in general cargo as a result of the restoration to normal activity of the East Coast ports and the reduction of the war-time traffic following the conclusion of hostilities.

An encouraging feature is the increase in general cargo exports compared with the pre-war level, more particularly as this type of cargo employs a relatively large amount of labour. In spite of this, however, the increase in general cargo does not compensate for the decline in the coal trade, so that, overall, there has been a considerable surplus of dock labour throughout the district, and it has been necessary to reduce the labour strength. The position is undoubtedly serious, and the reduction amounts to as much as 27 per cent. An even more alarming feature is the fact that these reductions were not confined to South Wales only, but were general throughout the West Coast ports.

Following representations by the South Wales and Monmouthshire Joint Port Committee, trading interests and the Government are exploring the possibility of making a greater use of the South Wales Ports for various types of general cargo. It has to be recognised, however, that, in the past, the ports in question have depended chiefly on a prosperous coal export trade, and as this trade shows no improvement, and, indeed, appears to be declining even further, an increase in general cargo brought about by the development of local industries through the building of Government sponsored trading estates seems to be the only solution to the problem.

Transport Restoration in Europe.

The beneficial activities of the European Central Inland Transport Organisation are well known in trading circles and much interest attaches to a report which has recently been issued detailing the extent of its operations since the conclusion of hostilities in Europe for the restoration of traffic routes by land, river and canal. Rail and road facilities are included in the survey, but the attention of our readers will naturally be more attracted to those of the waterways.

It is of interest to note that the French, Belgian and Netherlands waterways are nearly back to normal condition, though in some cases the bridges and other structures are of a temporary character to be replaced later by those of more substantial design. Some of the locks on the Albert Canal in Belgium cannot be brought into operation before the end of the current year. A good deal has yet to be done on the main Continental rivers, where wrecks and collapsed bridges have caused obstructions and in some cases irregular currents, with appreciable silting, which are creating difficulties for navigation.

The Rhine is stated to be again available for international traffic and the volume of civilian user rose from practically nil in August 1945 to about one million tons in May 1946. The Danube and the Elbe are less favourably circumstanced though serviceable in a moderate degree.

Port of Hull Development.

Arising out of a scheme for the construction of a bridge, estimated to cost £6,000,000, across the River Humber, west of Boston, it is proposed to impound the small tributary the river Hull from which the city takes its name. This was referred to at a Press Conference in London recently, at which Alderman L. J. Schultz, chairman of the Kington-upon-Hull Reconstruction Committee, outlined the major project, stating that it was a modification of the proposal submitted to Parliament in 1930-1. The main opposition to that proposal came from navigational interests, who felt that the construction of pier supports for the bridge, as then designed, might induce changes in the navigable channel which would be harmful to navigation. The revised scheme removes this objection by providing for a suspension bridge in a single span of 4,500 feet, which will be the largest of its type yet constructed.

The impounding of the river Hull would involve the straightening of bends in its course, and the provision of quayage, leading ultimately to the construction of a large turning basin at Stoneferry. This programme will add materially to the importance of the Port of Hull.

Lloyd's Register of Shipbuilding Returns.

The statistics just issued by Lloyd's Register of Shipping regarding merchant vessels under construction at the end of September last show that in Great Britain and Ireland there is an increase of 109,935 tons in the work in hand as compared with the figures for the previous quarter. The present total of 1,874,878 tons gross is also greater by 378,635 tons than the tonnage which was being built at the end of September, 1945, and has not been exceeded since June, 1922, when the total recorded was 1,919,504 tons.

This increase is gratifying and indicates substantial and definite progress in the country's recovery from its war-time stagnation. It will be some while yet before the one time British pre-eminence in shipping tonnage can be regained, but the prospect is encouraging, and the fact that British shipyards are engaged on more than half the world's present ship construction is noteworthy. The formidable transatlantic competition is evidently receding.

The vessels being built in the world at the end of September include 53 steamers and 57 motorships of between 6,000 and 8,000 tons each; 31 steamers and 54 motorships of between 8,000 and 10,000 tons each; 21 steamers and 33 motorships of between 10,000 and 20,000 tons; and 5 steamers and one motorship of between 20,000 and 30,000 tons. The preponderance of motor vessels continues to be a notable feature.

The Port of Mombasa, Kenya

An Historic East African Port

(CONTRIBUTED)

MOMBASA is a coral Island about 3 miles long and 2 miles wide situated about 4 degrees south of the equator in longitude 39° 40′ East.

It is surrounded by arms of the sea, and is connected to the mainland to the northeast by a floating bridge (Nyali Bridge) and to the westward by a causeway (Macupa Causeway) which carries the railway, a road, and the pipeline conveying Mombasa's water supply.

The somewhat tortuous arm of the sea to the eastward (spanned at its northern end by Nyali Bridge) has an average deep water width of 1½ cables (300 yards) and depths ranging from 6 to 20 fathoms. This arm constitutes the Old Port of Mombasa, now exclusively used by the Dhow Trade.

To the southeastward of the Island, the sea inlet expands in width from 2 cables at the seaward entrance to about 4 cables and, except for various reefs which do not interfere with navigation is deep (10 to 20 fathoms) throughout. This arm constitutes the modern deep water port of Kilindini.

Opening out to the westward from the northern end of Kilindini Harbour is a spacious sheet of water known as Port Reitz, which formed a useful overflow anchorage in the busy periods of the war.

Between Macupa Causeway and Nyali Bridge, i.e., off the short northern shore of the Island, lies Port Tudor, used only by small dhows collecting firewood, etc., from the creeks.

Mombasa is about 1600 miles from Aden, 2100 from Muscat and 2500 in a straight line from Bombay.

A fortunate device of nature has from time immemorable facilitated human intercourse in this part of the world.

Every December the wind (monsoon) commences to blow from the north-north-east and persists with remarkable steadiness until the end of February. From April to September the reverse is the order, a strong wind blowing from the south-south-west.

Merchant Adventurers, therefore, could be certain of a fair wind to take them steadily down the African Coast, and after a month or two of trading, another fair wind to take them home.

Early History

Thus arose a seasonal Arab, Persian and Indian Trade with East Africa with which Mombasa was prominently identified, historical evidence of which, and of Greek and Roman trading, is provided as early as AD. 80 by the "Pereplus of the Urythraen Sea" written by a Greek merchant seaman of that time.

Mombasa was visited from time to time by many noted Navigators. Marco Polo reported that many trading ships visited the place bartering the goods they brought for elephants teeth.

A visit to East Africa by Pero de Covilhao in 1486 led to the commencement of the strong Portuguese connection with the East African Coast and with Mombasa, as consequent on his report, Vasco da Gama was despatched from the Tagus in 1497 with four vessels, amongst the crews of which were a number of criminals "to be adventured on land in dangerous places," and one journalist. On the 7th April, 1498, da Gama reached Mombasa "a large city seated upon an eminence washed by the sea. The Port is entered daily by numerous vessels."

In entering the port, da Gama had some difficulty with his pilot, corrected by the application of boiling lard, a practice now happily discontinued. This and other incidents commenced a century long quarrel between the port and Portugal, during which the town was many times sacked. In 1528 for instance the Zanzibar people complained to Nuno do Cunha of the truculency of the Mombasa inhabitant, whereupon he burnt the town and destroyed its plantations. In 1585, and again in 1589, one Ali Bey, a Turkish corsair, drove the Portuguese from Mombasa and other ports on the coast. On the arrival of a Portuguese relief expedition, help was offered to Mombasa by the Zimbas, a remarkable tribe at that time overrunning East Africa. On admission to the town however, the Zimbas traitorously massacred the inhabitants, the carnage being completed by the muskets and cutlasses of the Portuguese. Subsequently the Portuguese defeated and broke the power of the Zimbas.

The Portuguese, realising the importance of Mombasa, commenced in 1539 the building of Fort Jesus, a historical pile still existant and now used as a prison.

Peace more or less reigned until 1631, when the Portuguese-educated Sultan massacred all the Portuguese under circumstances of great treachery and captured the port.

The iron disciplinary methods of the new 27 years old Portuguese Governor are still alluded to in the remnants of an inscription over the portals of the Fort. The East Coast of Africa was first visited by a British ship in 1591, the "Edward Bonaventura," under the command of Sir (then Mr.) James Lancaster, the direct result of this visit being the fomation of the East India Company of 1600.

Old Mombasa Port.

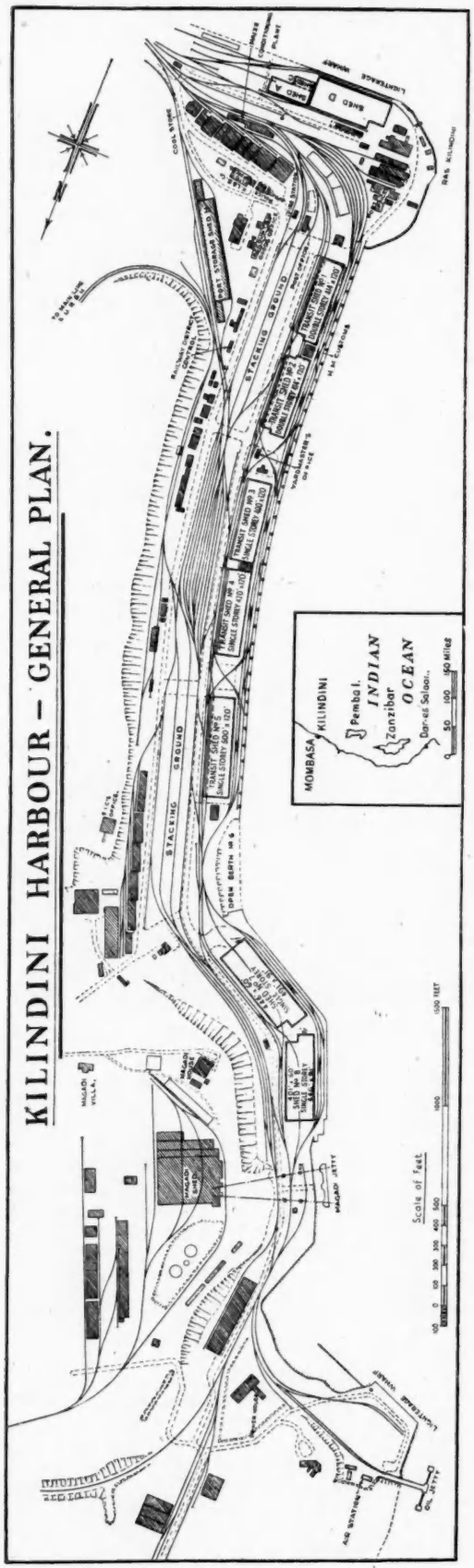
Between 1622 and 1710 the history of this part of the East African Coast is mainly of insurrection of the inhabitants against the Portuguese, and attacks in their aid by the Arabs, resulting in alternative occupation by Arab and Portuguese.

On the 15th March, 1696, the great 33 months siege of Mombasa by the Arabs commenced. After various attempts at relief and vicissitudes of plague and famine, the Arabs entered the port in December 1698, and put to death the surviving eleven men and two native women. Two days later a Portuguese relieving force arrived, but seeing the Arab flag flying over the port, retired.

The power which mainly drove the Portuguese from most of the East African possessions was the remote and comparatively obscure principality of Oman.

In 1698, the Oman Sultan, Seif, after the capture of Mombasa, proceeded to consolidate his rule along the coast, but, during an Omani civil war of succession, the Portuguese again captured and occupied Mombasa in 1728. Their occupation was again short lived, but about 1750 Mombasa, under an Arab Liwali or local Arab Governor, one Ali bin Osman of the turbulent Mazrui clan, declared itself independent. In 1804, with the death in the hour of victory of the then Sultan of Oman in a sea fight, the extraordinary and great Arab ruler Seyyid Said (then 14 years of age) entered the scene, and was acclaimed Iman on the 14th September, 1806.

Port of Mombasa, Kenya—continued



British Intervention and Influence

In 1822 Seyyid Said threatened Mombasa. With this threat begins the story of British intervention in East Africa. H.M.S. *Barraconta* arrived at Mombasa on the morning of the 4th December, 1823, and her Commanding Officer, Capt. Vidal, was thereupon beseeched by the people of Mombasa, in view of the Omani threat, to authorise them to hoist the English flag and to take the town and territory into the hands of His Britannic Majesty.

This was refused, but on the 10th March following Capt. Owen in H.M.S. *Leven*, on visiting Mombasa, found an investing force exchanging fire with the Fort, and an improvised British Flag flying over that edifice.

The flag was struck after the arrival of the *Leven*, but was later rehoisted by the sanction of her Commanding Officer cheered by the numerous inhabitants who saw themselves thus miraculously rescued from the threatened vengeance of the Iman of Muscat.

Provisional arrangements were made, among which the abolition of the slave trade was the principal feature, and one Lieut. Reitz (who subsequently died at an early age at Mombasa, and after whom is named Port Reitz) with a supporting force was left in charge as Commandant, and governed the town with unusual sagacity in one so young. After about two years the British protection was however repudiated and in 1829, Seyyid Said attacked Mombasa with the consent of the Indian Government, defeated the Mazrui, and garrisoned the town with 300 Baluchis.

Seyyid Said then left for Zanzibar and started that Island's famous clove industry.

After three months, however, disturbances in Oman necessitated his departure, the Mazrui starved the Mombasa garrison into submission and it was not until 1837 that they (the Mazrui) was finally subdued. In 1832 Seyyid transferred his court from Oman to Zanzibar, then the gateway of Eastern and Central Africa, and a period of unexampled prosperity followed.

The Arabs who came with the Iman were the pioneers of exploration in Africa and the inspirers of the subsequent European explorers.

Seyyid Said was undoubtedly a great Statesman, friend of the British, and against the wishes of his people, the main force in the suppression of the slave trade in these regions. He died at sea in October, 1856, at the age of 67.

Under Seyyid Said, British influence was practically paramount in Zanzibar, and the succession to Said was settled by Lord Canning when Viceroy of India in 1861. In 1872 the British India Steam Navigation Coy. established regular communication between India, Zanzibar and Europe and in 1877 the Sultan offered that Company a concession of his mainland dominion, the British Government was not, however favourable to its acceptance, and the offer lapsed.

On the 24th May, 1887, however, the Sultan granted the " British East Africa Association " a concession on certain of his possessions on the East Africa Mainland, and on the 3rd September, 1888, the Association was incorporated under a Royal Charter, with Sir William Mackinnon as Chairman. In the same year a similar concession was granted to the Germans in respect of an area to the south of the British area.

Favourable reports by Lugard, Portal and others upon the future of Uganda, the fear of French designs upon the Nile, and the insistence of missionary interests in England, combined to cause the construction of the Uganda Railway. A preliminary survey was made in 1892-3, the first rails were laid in Mombasa in 1895, and by the end of 1901 there was a weekly train service from Mombasa to Lake Victoria.

In the meantime, following on various administrative difficulties, rebellions and mutinies, a British Protectorate was notified on 1st July, 1895, and on the 14th December of that year an agreement was reached between the Sultan of Zanzibar and the British Government, and the Chartered Company (the self-sacrifice and imperial nature of whose work is often forgotten), were bought out.

On the 31st August, 1896, the limits of the East African Protectorate were proclaimed, and on the 5th March, 1902, the territory known as the Eastern Province of Uganda, was added to the new protectorate. Various further boundaries were later defined, and on the 23rd June, 1920, the interior of what had been known as the East African Protectorate became the Colony of Kenya, and the ten mile strip on the coast became the Kenya Protectorate.

Constitution of Old Port

The Old Port and Marine Department of Mombasa had been constituted in 1898, and attention given to the establishment of aids to navigation.

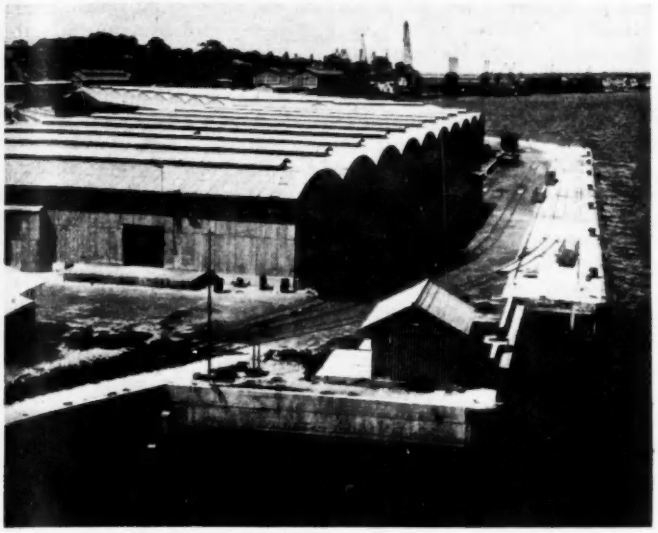
In 1900, the first modern attempt at coast lights was made by the erection at Mombasa of a fixed light, visible 12 miles, near the position of the present light-house; and in 1903 the present lighthouse was built and the old one removed to Malindi, where it is still in use.

In the same year Indian Pilots were appointed to assist in taking ships into and out of the harbour.

Port of Mombasa, Kenya—continued

In 1917 an Assistant Port Officer was appointed, and two posts of pilot were created and filled in 1918 and 1921 respectively.

With the advent of the Port Ordinance in 1922 compulsory pilotage was established at Mombasa, and additional staff were subsequently appointed as necessary.



Kilindini Harbour—Berth No. 8.

In 1926, Mombasa was declared a port of registry of British ships.

By 1901 Mombasa had become the coast terminal port of a railway about 500 miles in length, passing right through Kenya to Uganda, but, built mainly for political reasons and the suppression of the slave trade, passing through comparative undeveloped country.

Trade Development

In 1892 it had been estimated that the immediate yearly traffic after the opening of the railway would be:—

Exports of ivory, wheat, other grain, coffee, groundnuts, etc., would be	9950 tons.
Exports of live stock	5500 head.
Imports of all kinds from Europe and India	1740 tons.
Passengers (assuming that three times as many people would travel by train as then did by caravan)	11400

not an inventory likely to call for heavy port development, and one that could competently be dealt with by lighter, and it was as a lighterage port that Mombasa adequately dealt with its traffic for some years.

With the settlement of the country, and with the railway already in existence, development proceeded apace, and the following figures relative to the export of some of the principal agricultural products indicate how rapid was the progress.

	Year ended 31st March, 1914		Year ended 31st December 1924	
	Quantity	Value £	Quantity	Value £
Cotton (centals) ...	110,664	358,564	515,095	3,483,329
Coffee (cwts) ...	17,272	47,438	199,504	803,313
Sisal (tons) ...	1,073	12,525	11,416	396,777
Maize (cwts) ...	129,855	34,715	1,164,479	381,272
Cotton Seed (tons) ...	7,776	29,774	21,095	106,290

In the same period as for the above figures, imports consisting chiefly of manufactured goods, agricultural and other machinery, cotton piece goods, iron and steel, etc., increased from the value of £2,147,937 to the value of £6,178,547 (exclusive of bullion and specie).

With these rising tonnages, stock had to be taken of the capacity and capabilities of the terminal port. Two deep water berths had been commenced in 1921, but in 1925 the port was being worked in the main by two lighterage companies, the East African Lighterage Company, Ltd., and the African Wharferage Company. These two companies owned between them 10,137 tons of lighterage capacity, and had a further 2,320 tons under construction.

Their activities included not only lighterage, but the handling of all cargo from ships' slings to point of delivery to consignees or their agents in the case of imports, and from the point of receipt from the shippers or their agents to ships slings in the case of exports.

There were then six principal landing and shipping places at which cargo was dealt with, viz.:—

(a) The Government Lighterage Wharves at Kilindini, the property of the Railway Administration.
(b) A wharf at Mbaraki, near the Kilindini Harbour entrance, leased to one of the Lighterage Companies.
(c) A small pier at Mombasa controlled by the Customs Department.
(d) A private pier at Shimanzi, at the northern end of Kilindini Harbour, belonging to the Magadi Soda Company (almost pure soda is recovered from Lake Magadi and exported).
(e) A dhow landing place in the Old Port of Mombasa, controlled by the Customs Department.
(f) There were also the two deep water quays commenced in 1921, but not used by shipping until August, 1926.

Of the above landing places, the most extensive was (a). These wharves consisted of a main wharf 549-ft. in length, equipped with one 10-ton, two 5-ton, one 3-ton, two 2-ton steam cranes and one hand crane.

An export jetty 120-ft. in length, unequipped with cranes, a maize wharf, also unequipped with cranes, 112-ft. in length, and a lighterage wharf, 300-ft. in length and equipped with two 3-ton derrick cranes, for the landing of permanent way material. There were various sheds and stacking grounds.

Kilindini Harbour—Sheds 1 to 5 and Stacking Ground; King's Warehouse in Foreground.

The Mbaraki Wharf (b) was leased to and operated by the African Wharfage Coy. for export traffic. It had recently been purchased by the Railway Administration from private ownership.

Inception of Harbour Advisory Board

It will be seen that the various landing places were under the control of various authorities, and, although a Port Advisory Board had been appointed in 1920, and since that date had continued to function in an advisory capacity to H.E. the Governor on matters relating to the port, and to co-ordinate the work of the various departments and interests, it was high time for evolution of a unified system of control.

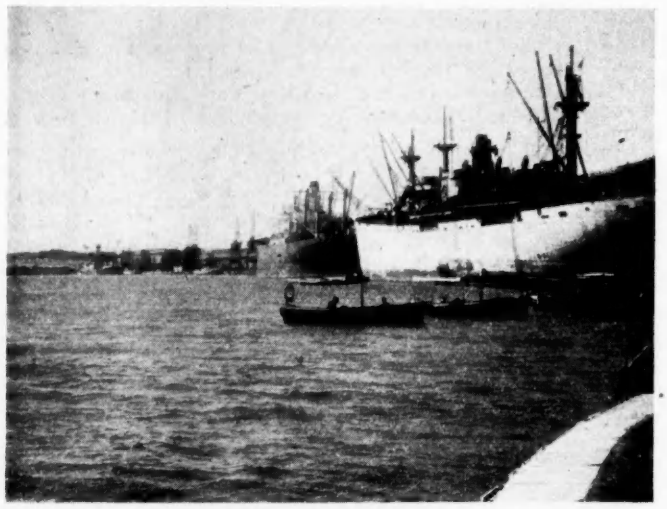
Port of Mombasa, Kenya—continued

A commission of enquiry was accordingly convened and after due deliberation, made the following recommendations:—

(a) That the harbour be placed under the control of the General Manager of Railways.
(b) That the General Manager exercise his control through a Port Manager, in charge of the harbour, ashore and afloat.
(c) That a Harbour Advisory Board be constituted to advise the General Manager and the Port Manager in the working of the harbour.

These recommendations were adopted, and during 1927, the control of all ports and harbours on the Coast of Kenya was vested in the High Commissioner for Transport, with Management under the General Manager of Railways and Harbours, exercising his control through a Port Manager.

To avoid duplication of work and to effect economy, the Railway Engineering, Stores and Accounting Departments catered also for the port services.



Kilindini Harbour—Quays 1 to 5.

The Harbour Advisory Board was established by Order in Council, and is constituted as follows:—

(a) The Commissioner of Customs as Chairman.
(b) Three commercial members, one appointed by the Association of the East African Chambers of Commerce, and two by the Mombasa Chamber, it being a condition that none of these members must be persons employed by, or connected with any shipping company.
(c) Two members, selected as representing shipping interests, appointed by H.E. the Governor of Kenya.
(d) Two members appointed by H.E. the Governor of Uganda.

Development thereafter was rapid, as illustrated by the following figures:—

	IMPORTS			EXPORTS		
Year	General Cargo and Oils Tons	Coal Tons	Total Tons	General Cargo and Oils Tons	Coal Tons	Grand Total
1922	—	—	—	—	—	262,203
1925	207,486	68,486	275,972	223,299	—	499,271
1930	256,059	108,017	364,076	318,761	—	682,837
1935	355,697	92,146	447,843	482,979	—	930,640
1940	740,378	120,585	860,963	524,109	11,938	1,397,010
1945	621,763	236,971	858,734	784,284	33,214	1,681,232
(Record year 1941)	986,050	140,072	1,126,122	916,434	59,414	2,101,970

The number and tonnage of ships visiting the port during the years is as under:—

Year	No. of Steamers	Net Registered Tons
1925	440	1,180,493
1930	663	1,904,266
1935	663	2,090,134
1940	644	2,239,490
1945	538	1,772,014
(Record year 1942)	883	2,894,893

The largest vessel to enter the Port of Mombasa and berth alongside the deep water quay at Kilindini Harbour to date is the *Ile de France*, of 43,450 gross tons, on 28th November, 1945.

Since the 1st July, 1927, the whole of the shore-handling and lighterage of cargo at the Port of Mombasa has been performed by contractors under agreement with the Railway and Harbour Administration. On the same date the water-front transit shed at Mbaraki, formerly worked by a private company, were absorbed into the Kilindini Harbour Area, conveyors were installed and the water-front was developed for landing, stacking, and railing coal.

On first December, 1927, the shore-handling contractors to the Administration also undertook the work of loading and unloading railway trucks within the Kilindini Harbour Area.

The year 1927 was not only the first year during which the Administration of the Harbours and Railways came under one management, but was also the first complete year during which berths Nos. 1 and 2 of the new deep water quays at Kilindini Harbour were in full use. The facilities were so much used and appreciated, and the need for more accommodation was so apparent, that two additional berths were put under construction.

Berth No. 3, complete with transit shed, quay and shed electric cranes, rail track and roads, was ready for use on 1st January, 1929, Berth No. 4 was ready for use on 1st June, 1929. Berth No. 5 was completed on 5th February, 1931, and Berths Nos. 7 and 8 on 1st June, 1944 and 1st September, 1944, respectively.

The construction of a deep water jetty for dealing with bulk and cased oils was completed on 8th July, 1931, and the oil companies transferred their installations from Kilindini Bay to Shimanzi, where they have since been extensively developed.

War Record

The entry of Italy into the War in 1940 brought Mombasa into prominence as the port of entry for South African and Imperial troops and equipment in the campaign against Abyssinia and Somaliland. At times the harbour was packed with transports but fortunately the much expected bombing of the port did not materialise.

When Japan came into the War, Mombasa became a port of call for Imperial troops bound for the East and also for the embarkation of East African troops. With the fall of Hong King and Singapore, Mombasa again came into prominence as a Naval Base. In May, 1942, the Third Battle Squardon (Eastern Fleet) put into harbour, and for about a year thereafter, the port was used as the base of the Eastern Fleet. At one time there were some 200 war auxiliary and merchant vessels using the port, and its capacity was taxed to the utmost; the auxiliary anchorage of Port Reitz then proving of inestimable value.

A naval dockyard was constructed at Kilindini, and a large number of camps and naval buildings were erected on the Island, including a "Wrennery" to accommodate hundreds of W.R.N.S.

The Headquarters of the Eastern Fleet were situated ashore at Mombasa.

The Naval population has now dwindled to a mere handful, and the camps, etc., are rapidly being demolished.

The port was also used as the embarkation base for the Madagascar campaign, and for some weeks training of the landing parties and craft were realistically carried out in the harbour.

Kilindini Harbour now has a deep water general cargo quay 4,089-ft. in length, giving seven berths accommodating ocean-going vessels, with a maximum draft of 32-ft. for Nos. 1 to 5 and 30-ft. for Nos. 7 and 8; a conveyor served berth with a depth alongside of 27-ft. at L.W.O.S.T. (chiefly used for the export of soda); and a special jetty for the discharge of bulk oils.

There should be a great future for this deep water harbour of East Africa, and fortunately there is ample room for development as it is needed.

Sunday Docking at Newport.

The pre-war arrangement under which, except in special circumstances, only one tide is worked on Sundays has been re-introduced at Newport as from October 20th. Docking and undocking of vessels will proceed normally on the p.m. tide each Sunday and on both tides each week day.

Dock Labour: Decasualisation Problems

(CONTRIBUTED)

Some readers of the article on "Decasualisation of Dock Labour," which appeared in the October, 1946 issue of *The Dock and Harbour Authority*, will contend that it dealt with the matter from a somewhat narrow angle. No one will complain of this, provided it is remembered that an angle has more than one side. Decasualisation of labour is an ideal to which all enlightened men would wish to work. It is in line with the spirit of the times, and even its complexity in relation to certain forms of employment will not deter those who are seeking a solution to the problem. The difficulties, indeed, are great, but was it not Mr. Churchill who in a crisis of the war said, in effect, "Don't talk to me about the difficulties; they will argue themselves?"

Let us then allow the difficulties of decasualisation of dock labour to argue themselves. The crux of the whole matter is the necessity of keeping the size of the registers at the different ports in reasonable relationship to the amount of work available. At the moment there are two ominous facts to be faced: the heavy redundancy of dock labour; and the high expenditure on guaranteed payments under dock labour schemes.

To have an efficient dock labour force there are these alternatives: (a) Sufficient men to secure the satisfactory working of each port; or (b) a number large enough to meet peak demands.

It is obvious that (b) must be discarded by employers. Clearly no scheme of decasualisation could support, on an economic basis, a labour force to meet peak demands. These peak demands, however, must be dealt with; the problem is how? They arise in many trades, e.g., Baltic timber, which is shipped during some months only of the year.

In industry machines can be speeded up, or worked on extra shifts, depending on whether the demand is short-term or long-term. The electrical engineer is happy when he can work on a "level curve." If the demand for current rises, at some point he can start up another generator, until the plant has reached its maximum output, when, as we know to our concern, he starts to "shed" his load. The human machine is not, however, elastic. There is a limit to the number of hours a man can work, and to the output of which he is capable. In the nature of things ships do not arrive at regularly-spaced intervals at just those ports where the labour available meets the ships' requirements.

If (b) is discarded and we fall back on (a), there will at times be delay to ships and cargo, unless it is possible to find some method of meeting peak demands. Clearly some system which falls between the limits of (a) and (b) and which is sufficiently flexible to meet the essential needs of the case, cries out for adoption. Is it possible to devise such a system?

It has already been stated that the crux of dock labour decasualisation is the adjustment of the size of the registers to the work available. It follows, therefore, that no scheme will be successful unless it is efficient and solvent, and so devised that it is incapable of being developed into a pension scheme for redundant, or inefficient workers.

If it be granted that this particular industry cannot unaided shoulder the whole burden of decasualisation, the question arises: "Can it shoulder a part, and, if so, what proportion?" Should the employer bear the cost of decasualisation under (a) and the State under (b)—in other words the exployer provide for the number of men in each port for whom work is normally available, and the State for the "extras?" Such a solution will, of course, not satisfy everyone, but it is improbable that any solution will. A sound argument can be made out for the proposition that the cost of complete decasualisation should be shared between the employer and the State.

It is interesting to toy with the idea of "flying squads" of dockers able and willing to go anywhere at a moment's notice. Before the war there were some industries—constructional engineering and building among others—in which mobility of labour was an established practice. There was nothing comparable to it in the dock industry. True, during the war there was a large measure of mobility, but that was in a time of national emergency, when all were keyed up in the national effort. It is not inconceivable that this idea of mobility, on a national scale, might be developed in the future. It might well be that young, active men might be willing to transfer from port to port, and it might equally well be that a higher rate of pay to ensure that men could be used, say, in Swansea one day and in Newcastle the next, would be worth while as an alternative to keeping a large body of men unemployed or partly employed, on pay, in one or other of the ports.

Dock labour schemes have brought about a complete revolution in the dock industry. Before the war there was serious unemployment of dockers on the register; not only that, there was a big pool of unregistered labour available. Now, dock schemes guarantee engagement of all the men on the port register who present themselves for work. It is important, however, to make quite clear what the use of the word "register" means. The "register" before the war was merely a list of men, drawn up by the trade unions and the employers, to whom the latter were willing to offer work if it was available. If it was not, they were under no obligation towards these men. Thus employers had no objection to any man of decent type becoming registered, if he so wished. The position now is entirely different. By accepting the man on to the register the employer is entering into an obligation to keep him on pay, providing he behaves himself. It can scarcely be expected, therefore, that the employer will accept on to the register, under these new conditions, any more than that number of men for whom he can foresee a reasonable degree of regular employment.

Under the pre-war plan, there was no objection at all to dual control over entries to the register, for the simple reason that neither employers nor union representatives were under any obligation towards those who registered. Because the registers of dockers are still known by the same name throughout the country, it is argued that the employees' representatives should continue, as before, to have joint control of the registers. It is unfortunate that it is not more widely understood that although its name has not changed, the purpose and objects of the register have. It must be obvious that those whose duty it is to guarantee payment to those registered, must control the numbers on the register—though one can see no reason why the selection of those who are to enter should not be a joint responsibility.

It has been found that the daily surplus of labour and the weekly deficit on management funds have in some ports reached levels which can only be described as alarming. Some of the figures have been published, and they have caused grave concern. The position throughout the whole of the year has been disquieting, although during the last few weeks there has been some slight improvement in certain directions.

Can it be expected that the situation will right itself? While it is reasonable to expect some improvement—perhaps even on a considerable scale—in trade, he would, indeed, be an optimist who suggested that within any foreseeable time there will be enough trade to warrant the maintenance of a dock labour force of its present size. If redundancy can be eliminated by various means—in this connection it must be realised that the average age of the dockers of to-day is high, because, owing to the war, there has been no normal recruitment since 1939—there still remains the difficulty of providing for abnormal labour demands.

It has been suggested that agreement could be reached whereby dockers, trimmers, riggers and fish dock workers—the four main occupational groups—could be more readily interchangeable. But the difficulties seem almost insoluble. There is technical skill required for all of these jobs, and those who have the qualifications to belong to one of the categories, have not the training and experience to fulfil the duties of the others. This is the major obstacle to interchangeability between grades of work. Another important point is that the times of call and the hours of work are different. It is also the fact that clothing suitable for one job is unsuitable for another, and that much time might be lost in transferring from section to section. In spite of all this, however, it may be that the idea of interchangeability of labour will have to be gone into in the future, and there must undoubtedly be greater mobility of labour of a similar grade between ports within the same geographical group, as exemplified, say, between the Clyde, the Humber and the Wash. Another necessity is that of the redistribution of dock labour as between ports, now that war requirements have ceased and given place to peace-time needs.

Having taken account of these points, the fact remains that

Dock Labour: Decasualisation Problems—continued

some sort of reserve labour pool would seem to be indicated as a way out of the difficulty, expensive and time-wasting as the transfer of men from port to port, or from section to section, may prove to be. Some areas may be fortunate in that there are seasonal trades which enable men to be drawn from them at just those periods when they are needed at the docks—for example, after the potato and sugar beet crops have been lifted.

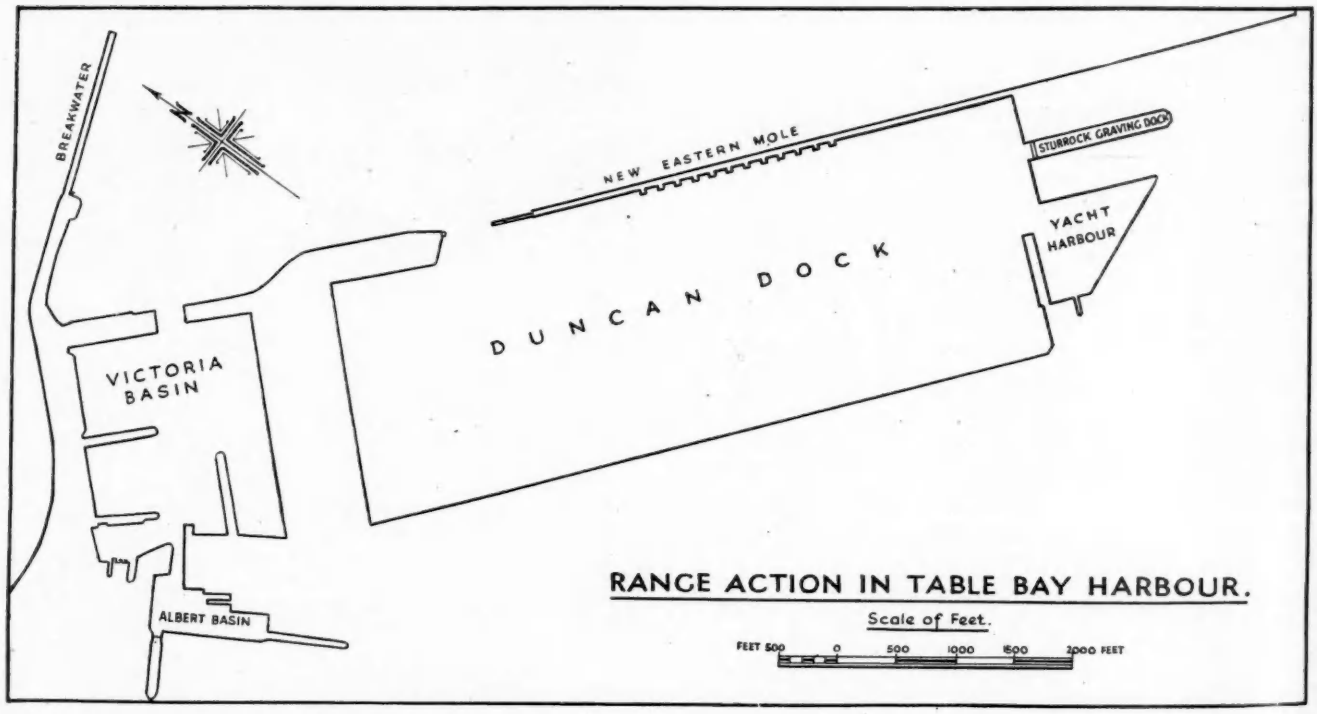
To the smaller ports decasualisation presents a special problem. If ships do not arrive at regularly-spaced intervals at the big ports, still less do they do so at the small, where all the disadvantages from the employment standpoint of infrequent calls are exaggerated. The long-standing practice in such ports has been a seasonal flow of local labour from various forms of shore employment to the docks, and back again. Are these men to be tied in future to the docks, to idle half the year away on pay? This will scarcely satisfy the ideals of full employment. If decasualisation on such terms had to embrace certain of the small ports it would greatly increase the financial burden of the scheme on the country as a whole. Coastwise shipping, too, has its own peculiar difficulties. The burden of extra labour charges in United Kingdom ports falls heavily upon it, with its almost daily calls at the smaller ports around our coasts. This is unfortunate, since it can claim to be probably the steadiest and most consistent employer of dock labour among all shipping sections. The *entrepôt* trade, too, calls for particularly expeditious and economic handling of ships; it is in this way that British ports are able to compete with their Continental competitors.

" Decasualisation," said the writer of the article in the October issue, " means a happy industry, continuous employment for dock workers, a 100 per cent. efficiency, and a speedy turn-round of ships, and an opportunity for this country to obtain first place in the race for the markets of the world." If all these benefits could be guaranteed through decasualisation, it might be that the price, heavy though it would be, was worth while. But it is suggested that the issue is not capable of being quite so simply expressed.

Range Action in Table Bay Harbour

Official Investigation by means of Harbour Models

In the issue of May last, attention was called to the decision of the Cunard-White Star management not to allow the ss. *Aquitania* to be berthed at the Duncan Dock, Cape Town, on account of the liability of the basin to experience surge or " range " action and it was stated that an official investigation into the phenomenon was in course of being made. Through the courtesy of the General Manager of the South African Railway and Harbours Administration the following account of the steps taken and the results obtained has been received for publication:—



In Table Bay the movement of water known as " range action " has obtained since the harbour was built. While troublesome to shipping and causing the breakage of mooring ropes at times, it did not hamper the development of the Port and the regular use by it of vessels of up to about 27,000 tons, and of considerably greater tonnage at irregular intervals. Attention was focussed on it in 1941 by one of the stormiest winters experienced during the last half-century, at a time when the harbour was crowded with convoys, and ships had to be berthed wherever space could be found. The most serious damage to a ship occurred at a place in the Duncan Dock, then under construction, where berthing would under normal circumstances not have been allowed.

The winter of 1941, reported the worst since 1900, resulted in the decision to institute a thorough research into the question. A model was constructed in 1943, in a building specially constructed for the purpose.

Range action is usually heralded by the advent of a storm, although it has been known to develop under relatively calm conditions. It has been established that this movement of water is related to weather disturbances as far as 1,000 to 2,000 miles away across the South Atlantic. It is found in harbours on the Pacific side of America, on the East Coasts of Madagascar and India, in various ports of Australia and New Zealand and in other parts of the world. At some of these places costly and lengthy experiments are known to be in progress in connection with " range " action. War interfered with French experiments and American experiments have not reached finality.

This movement in Table Bay may be resolved into harmonic components of large periodicity, from about 100 seconds to 15 minutes and more, although a periodicity of about 50 seconds has also been detected on occasion.

Range Action in Table Bay Harbour—continued

Conditions identifiable as range occur sporadically, and during the last five years, which included the exceptionally bad winter of 1941, and a bad winter also the following year, were inconvenient to shipping on relatively few occasions.

There was comparatively very little range in 1942 to 1945, and during this winter season (1946), up to the end of June, range has been reported on occasions, but only to a degree that has not inconvenienced shipping. This has hampered investigations considerably, especially in respect of the period after the Duncan Dock more or less assumed its final shape—about the middle of 1945.

It has been found that in the model, the Duncan Basin "resonates" to two sets of frequencies. One set corresponds to transverse oscillations of water in the basin, while the other set corresponds to longitudinal oscillations. (Slightly on each side of each of these natural frequencies there are some forced frequencies).

In the model, the transverse oscillations can be almost eliminated by constructing a jetty about 900-ft. long from and at right angles to the wharf at the north end of the basin, and about halfway across the Basin. It may be considered that such a jetty prevents the "to and fro" motion of the water at the node, or alternatively, that about half the expanding "wave" impinges on the jetty and, by reflection, is thrown about 180° out of phase with the other half which passes to the south of the jetty across the Basin. The two portions are thus made to counteract each other. The period of these transverse oscillations is about 1.8 minutes, and it is the half period of this (roughly about 50 seconds) which has been detected to a slight extent.

The longitudinal oscillations can be damped out in the model by moving the entrance southwards to about the mid-length position of the Duncan Basin. But these oscillations have a mean periodicity of about $5\frac{3}{4}$ minutes (the periodicities are affected by the small craft harbour at the south end of the Basin) and it seems very doubtful whether they affect shipping to any extent.

The remaining problem is, therefore, to settle this point, and also to determine which of the forced transverse periodicities which can be produced in the model occur in the basin itself. This last is of importance, because the oscillation having one of these forced transverse frequencies is aggravated by moving the entrance to mid-length; although it can, in the model, be overcome even then by other means—and at extra cost if the work is carried out, which it is sought to avoid.

It is for the above reasons that some good (or shall we say bad) "range action" to elucidate these outstanding questions is wanted, and which is not being experienced so far.

Disturbances having a period in excess of about 10 minutes cause a slight rise and fall of the water in the Duncan Dock (the longest period of this nature being, of course, that of the diurnal tides). This is always in action at intervals with an amplitude of an inch or two and is of no importance in this Basin, but in the Victoria Basin the period at which this action commences is about 4 minutes owing to its smaller size, and this appears to be the main disturbance in this Basin, although the oscillation 1.8 minute frequency also obtains, due to the width of the Victoria Basin being about the same as that of the Duncan Dock. The Victoria Basin has various jetties constructed inside it, however. A rise and fall action is apparently not so disturbing to shipping as a ranging (or "to and fro") motion, so that under the severest conditions such as in 1941, the effect was greater in the Duncan Basin although the amplitudes of the oscillations are apparently considerably less than in the Victoria Basin.

The model occupies the floor space of a building, 53-ft. by 42-ft., and reproduces the whole of Table Bay, as far north as Robben Island. Blaauwberg Strand, the Milnerton Beach, Woodstock and the whole of the harbour area up to Mouille Point are shown. The model is built to a scale of 1-in. to 100-ft. longitudinally, and 1-in. to 12-ft. vertically. The time scale is determined solely by the ratio of the horizontal and vertical scales and the known speed of a very long wave in water. Thus, while the model reflects water movements in miniature, the time factor is accelerated 100 times. For instance, an event which takes place in 5 minutes in nature occupies 3 seconds when reproduced on the model.

Electrically-operated paddles are used to reproduce the movements of the sea, which are accurately reflected in the different parts of the harbour, as shown on the model.

Small "pressurepots" connected by rubber tubing to manometers, in the tubes of which there are small floats connected to levers, record the rise and fall of the water at four places in the model on a revolving cylinder on smoked paper. The "record" may be "fixed" afterwards in a solution of shellac in alcohol.

Correspondence

To the Editor of *The Dock and Harbour Authority*.

Dear Sir,—

A Six-Hour Day for Dockers

At the risk of incurring a little temporary displeasure I am going to plead for the introduction of a 6-hour day for Dockers, because I am convinced that to shorten the hours of employment, with certain provisos, would benefit everyone in the industry.

No one, I suppose, will deny that, in winter time expecially, there is, comparatively speaking, very little work done between the hours of eight and nine o'clock in the morning, simply because so many of the men have to be up early in order to get to work on time, have little or nothing to eat before they leave home, and when they get to the docks they are either cold or hungry, or both, usually both, and their first thoughts, therefore, are of a "can of tea and something to eat"—a familiar cry in dockland.

It is the most natural thing in the world for a man who is shivering with the cold, and has his shoulders hunched up round his ears, to make an early dive for the canteen, if there is one available, or go off on his own, or with some of his mates, usually the latter, to satisfy his and their appetites, somewhere.

Do what we will, men **will** "spell out" for this reason—and others, it is agreed, a smoke being only one of them.

Many attempts have been made to stamp out "spelling"—with what result those who are familiar with the conditions obtaining in dockland, and what goes on there, know only too well. It is a very old practice, and unless the cause of it is removed the practice will continue.

Another contributory cause of the small output before nine o'clock in the morning is the poor light. Often enough it is not daylight by nine o'clock, and all the quay lights and "clusters" in the world do not even begin to make up for this. Good work has sometimes been done by their use,, admittedly, but they are at best a poor substitute for daylight. Men—particularly those in the holds of a ship, or on the quays—simply cannot work as efficiently by the one as by the other.

Precisely the same remarks apply with regard to winter afternoons. That is to say: after four o'clock there is little work done because of the failing light, by four-thirty the men start to hatch up, and soon after that they begin to drift away.

Nor is this confined to one ship, one employer, or one port. It is a widespread practice. In fact, during the summer months also there is not the amount of work done between eight and nine a.m. and four and five p.m. to warrant the capital outlay.

If, therefore, the men were told that henceforth their hours of employment were to be from nine until twelve, and from one until four, six hours in all, and that **during those hours they would be expected to work all the time,** the men would, I am convinced, be willing to give a better output than now, when they are supposed to work eight hours per day.

This would mean that the ship would have to be unhatched in time for a prompt nine o'clock start, and hatched up again after four o'clock, but that is merely a matter of arrangement. To leave it until the men—or the majority of them—have assembled on the quay and ship, before the shipped is rigged and stripped and got ready for working, or,if she is rigged, until the hatches have been removed is, in my opinion, just silly. It is a practice which has a bad psychological effect on the men, and encourages them to meander off, somewhere.

Obviously such a reform as I am advocating could not be introduced without the co-operation of the men's Union officials, and they would have to be asked to agree to the shortening down

Correspondence—continued

of the number of men per gang by one or two. It is because there are to-day—in some cases, at any rate—too many men in a gang that the "spelling" practice can be, and is, indulged in so frequently and effectively. If the men are challenged they say—and not without some justification—that if the work does not stop, but if, on the contrary, the "hook" continues to go up and down with the same regularity, the stevedore has nothing of which to complain. He in turn feels that he is in a pretty hopeless position, and—occasionally—is just a little sympathetic.

There is nothing new in this idea. A six-hour day has been advocated for many years past, but so far as I know no one has hitherto suggested its introduction into dockland—which is where it can be tried out to the profit of both employer and employee.

There should be no reduction in pay to the men for the shorter hours worked—always provided, of course, that their output was at least equal to what it is to-day—and "overtime" should be the exception rather than the rule. Men never have and never will be able to do as much in two or three hours overtime as they can do during a similar period when they are rested and fresh, or not overtired.

In the case of a hurry-up job two six-hour shifts might have to be worked, but it would be idle to expect the men to work as well and efficiently during the hours of darkness as when daylight is with them.

None know better than I do how annoying it is to see men drifting off in batches to the canteen two or three times a day, and at the end of the day, when the returns are available, to have to face the fact that the output per gang per hour leaves a lot to be desired. And it is because I have studied this problem for many years—to be precise: ever since I myself went to sea, which was in my youth, and that is a long time ago now!—and am convinced that there is only one solution to it, that I have put forward this plea.

If this scheme be considered too drastic for universal application forthwith, then my recommendation would be that it should be given a trial, with the approval of all concerned, by one stevedore, or at one small port, for a period of (say) three or six months, it being clearly understood by all parties to the experiment that employer as well as employee must stand or fall by the result.

In conclusion, it is not without interest to recall that there has lately been trouble on the Merseyside through some of the men in the shipbuilding industry "spelling out" and leaving their jobs before the appointed time.

Bromborough, Yours faithfully,
Cheshire. GEO. B. LISSENDEN, M.Inst.T.

To the Editor of *The Dock and Harbour Authority*.

Port Administration

Dear Sir,—

I must thank you very much for publishing the extract from the paper which I read before the International Technical Congress in Paris on "The Pre-War Systems of Port Administration with Suggestions for a Post-War Scheme," and for dealing with the paper so fully in your Editorial.

It was also very good of you to compare it with the scheme put forward by the Executive Committee of the Dock and Harbour Authorities' Association, but I must point out that the Executive Committee's scheme dealt solely with the problem of Port Administration in Great Britain, whereas my paper, which was read abroad, before an international body, did not deal only with the position in Great Britain, but rather confined itself to general terms and general principles which would require to be adapted to suit the individual needs of particular countries. As my background was the existing nationalised scheme in France, with its rigid departmental control, I perhaps did not stress sufficiently clearly that, far from wishing to leave all questions of policy and directive to a Government Department, as in France, or to transfer them to one, say, in Whitehall, I wished Government Departments to be deprived of all powers, except those which they would exercise in an advisory capacity.

As you agreed, the function of my Central Trust was not to be merely advisory, and it is intended that it should perform the majority of the functions performed by the Government in France, and to a large extent, the Ministry of Transport in this country during the war, and its independence from Governmental control should be at least as complete as that enjoyed by the large British Ports before the war, though it would have power over and be responsible for all of them. Under my proposals, the Ministry of Transport in Great Britain would only have powers to act in an advisory capacity to this Central Trust, which would in fact be a "Parliament of the Ports," and much more closely akin to a super P.L.A. than a Government Department.

I never have considered that as large a Central Trust would be necessary for this country, where all executives have been well-trained in Port affairs. Thus, the Technical Experts were put in with special reference to countries where the practice is for port executives to be switched from one Government Department to another without having time to acquire the detailed technical knowledge which is possessed by all port executives in this country.

The degree of centralisation and Government control which I envisage is nothing like as great as I think would be the natural outcome of the Dock and Harbour Authorities Association's scheme, which proposes, if I understand it aright, that the Advisory Council would assist the Ministry of Transport in regard to Port affairs. This pre-supposes that the Ministry of Transport, a Government Department, would be the final executive body, and I think that the appointment of an Advisory Council would have the ultimate effect of confirming the Minister of Transport in the position which he occupied during the war, of being the sole directing authority in the Docks industry. I fear that very soon the Port Trusts will find themselves in the position of being "chosen instruments," which would have to carry out the ministerial instructions and policies without having any means of expressing their views or negotiating with the Ministry, except through a Committee whose only function would be to advise the Minister, against whose decisions there would be but small right of appeal.

The main criticism made against my scheme on the Continent was that, owing to the small amount of Government representation on the Central Trust, it might become an irresponsible body as viewed from the national angle, but it is unlikely that that would happen in this country.

Yours faithfully,
J. H. HANNAY-THOMPSON,
Ph.D., B.Sc., B. Com., M.Inst.C.E., M.Inst.T.
Granton Harbour, Edinburgh.

[We are glad to publish this explanatory statement by Dr. Hannay-Thompson on his Port Administration Scheme. While accepting his disclaimer that he did not intend his Central Trust to be a Government Department (in spite of the assertion that it "should take over all Government functions") we fear the tendency would be for such a body to become in time affiliated to other Government Departments and to acquire their characteristic methods. Indeed, the same danger is to be apprehended also in the Dock and Harbour Authorities Association Scheme, though not perhaps to the same extent. We note that Dr. Hannay-Thompson was approaching the subject from an international standpoint which would, of course, as he claims, allow of variation to meet differing national conditions. Our comment was based on conditions prevailing in this country. Editor.]

Training Works on an Indian River

Influence of Preliminary Model Tests

A Paper on Training Works constructed in the Rupnarain River, Bengal, after Model Experiments, was read by **Sir Claude Cavendish Inglis, C.I.E., B.A., B.A.I., M.I.C.E.,** before the Maritime and Waterways Division of the Institution of Civil Engineers on February 5th, 1946. The following is a condensed summary of the Paper:—

The Rupnarian River is an important tributary of the Hooghly into which it flows opposite the ill-famed "James and Mary" Shoal, some 30 miles below the Port of Calcutta. In the mid-monsoon period of 1943 there were serious floods breaching the embankment of the Damodar River near Burdwan and causing local erosion and silting, in consequence of which the Rupnarain River became over-taxed and scouring took place. The fear of further encroachments, rendered it imperative to construct training works at once, and the Author of the Paper was called

Training Works on an Indian River—continued

upon to advise as to their design, which involved preparatory investigations with a scale model.

A small rigid tidal model of the particular reach in the river shown on fig. 1 was available at Poona, but no discharge data were on record when the experiments started, though it was estimated from the meander-length that the maximum discharge was about 300,000 cusecs. Tidal gauge readings subsequently became available for several points and from these, Mr. M. D. Kilford, Chief Surveyor of the Port of Calcutta, worked out detailed tidal curves for both "fair weather" and "freshet" spring tides, which formed the basis of all later experiments.

From the foregoing data, it became known that when tidal conditions are in favourable equilibrium, flood and ebb tides flow along approximately the same course, but where tidal conditions are unfavourable, the flood and ebb tides follow widely different courses. Analysis showed that the meander-length had been increasing before 1938 and that both the meander-length and the meander-width (belt) had increased rapidly after 1938.

The object of the experiments was two-fold:—

(a) to prevent further erosion of the left bank where it threatened the Bengal-Nagpur Railway line, and

(b) to deflect flow away from the left bank in the reach, towards mid-stream, so that it would swing round the sharp nose on the left bank of the river to pass sweetly through the railway bridge.

Three different designs of training works were tested in the model:

(a) A left-hand guide-bank upstream of the bridge;

(b) a long curved bank, extending for about 2,000-ft. from the left bank nose;

(c) a groyne, 1,100-ft. long, projecting upstream from the left bank at an angle of 60 degrees, at a point 4,200-ft. from the east abutment of the bridge.

The diagrams (Fig. 2) show lines of flow observed in the three alternative designs, for ebb flow. Although (a) gave fair results in the rigid model, it was clear from experience in the field that with this design erosion would continue behind the upper end of the guide bank and that the river would be pulled still farther to the left bank. This would finally cause a still deeper upstream embayment and still worse flow conditions through the bridge. Station design No. 1 (b) seemed to give slightly the best results in the model; but it would have been very costly and could not have been completed in one season; therefore station design No. 2 (c) which presented no considerable construction problem and was considered to promise the best long-term results, was recommended for adoption.

The experiments indicated that river conditions were best reproduced with a discharge of 0.5 cusecs, equivalent to 210,000 cusecs in the river. The following changes in the model occurred as a result of the groyne being added:

(1) The right bank channel began to develop and the river showed a tendency to revert to 1938 conditions.

(2) Erosion was checked downstream of the groyne.

(3) The left bank channel of 1944 deteriorated upstream of the groyne.

(4) Erosion occurred along the right bank close to and upstream of the right bank nose at Charnaguria.

(5) Erosion occurred at the left bank nose, and, as a result, accretion occurred along the left bank just downstream of the nose.

(6) Flow conditions through the bridge showed a slight improvement.

The groyne wholly in stone, was constructed under tidal conditions, stone being thrown on the bed ahead of the work in order to prevent deep bed-scour. A plan and section of the groyne are shown in fig. 3.

Although accretion occurred only to a small extent along the left bank in the model, yet it was possible to predict from experience, combined with close observation of flow conditions in the model, that accretion would occur in the river for some distance upstream and downstream of the groyne, leaving it earth-bound. It was also predicted that the accretion which occurred in the model just downstream of the left bank nose, due to material eroded upstream tending to accumulate at this point, would be much less in the river than in the model and might be more than counter-balanced by greater erosion of the nose in the river.

These anticipations have been realised and actually took place to a large extent in a single year.

The Paper concludes with a statement of the advantages derivable from the use of river models.

Fig. 1.

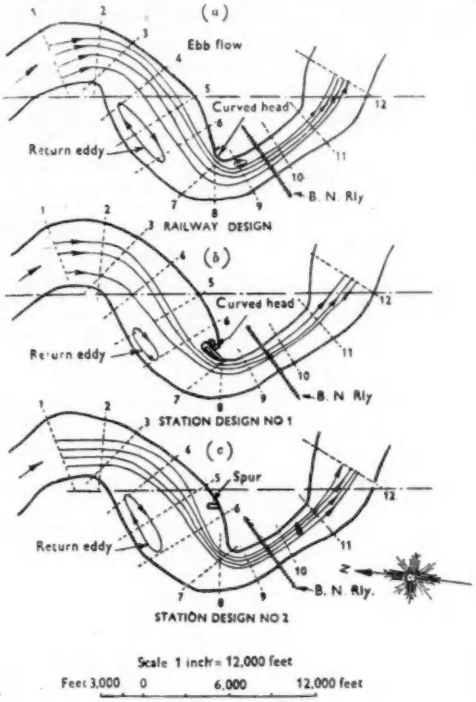


Fig. 2.

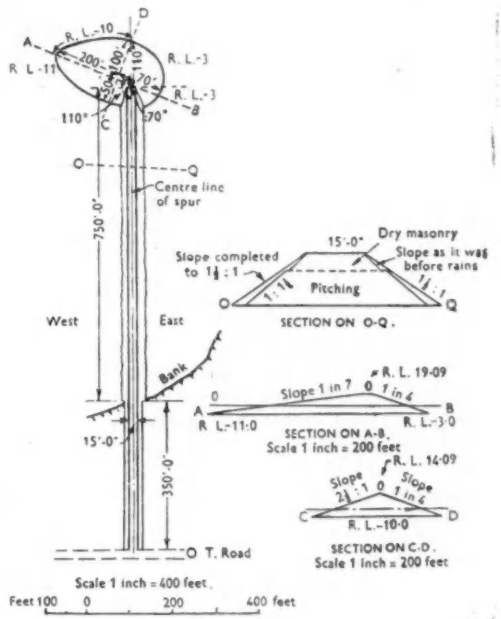


Fig. 3.

Notes of the Month

New River Port on the Volga.

The construction of a big river passenger port has begun at Gorky on the River Volga. With port buildings accommodating 10,000 people, it will be the largest port of its kind in the U.S.S.R. and about two and a-half times the size of Khimki port on the Moskva-Volga Canal.

Port of Sligo Improvement.

A scheme for the improvement of the Port of Sligo at an estimated cost £135,000, has been approved by the Harbour Commissioners, and the plans have been forwarded to the Department of Industry and Commerce for consideration by the Minister. If the plans are approved, half the cost of the proposed scheme will be borne by the Government of Eire and the other half will be contributed locally.

Ship Channel Proposed for Port of New Orleans.

Anticipating a considerable increase in trade within the next few years, the Port of New Orleans has submitted plans for the construction of a tide-water ship channel that will nearly double the present dock facilities. If completed, the project, estimated to cost $200,000,000, will cut off 50 miles of sailing for ocean ships visiting the port, by providing a tidewater instead of river route from the Gulf. The scheme is being considered by the U.S. Corps of Engineers, War Department, who have jurisdiction over all U.S.A. inland waterways and harbours.

Declining Port Traffic on Clyde.

A conference was held in Glasgow towards the end of last month, at which the Glasgow Corporation Post-War Planning Committee considered the present position of the Clyde dockers, who contend that trade is being diverted from the port and are perturbed at the prospect that they may become redundant to the extent that action may be taken. At present some 600 dockers out of the port's 3,500 are permanently idle, although receiving payment. There was a fall of 2,385,000 tons in the tonnage of vessels using the port in the eight-month period ending August last, and the tonnage of goods handled in that period also shows a decline, as against 1945, of 1,419,728 tons.

Port of Bristol Trade Returns.

The traffic returns for the six months ended September 30th, issued by the Port of Bristol Authority, show that the total of shipping handled decreased from 2,156,679 tons to 1,417,696 tons. Foreign imports at 1,338,983 tons decreased by 869,883 tons, while foreign exports were only 33,261 tons, compared with 178,902 tons. Coastwise imports and exports, while slightly below the totals for the corresponding period of last year, are being well maintained. The biggest decrease in foreign imports was in petroleum, which fell from 1,268,994 tons to 613,106 tons. Timber was down to 45,330 tons, against 87,414, but wood-pulp rose from 28,392 tons to 33,332. Grain imports showed a decrease of 71,789 tons.

Novel Cargo for Train Ferry.

The London & North Eastern Railway Company was recently asked to help over the problem of conveying aeroplanes for display in the Paris Exhibition, which opens on November 14. Because of the size of the aircraft, it has been found impossible to convey them by the usual Continental shipping services, in view of the fact that the fuselage of one of the areoplanes measures 47-ft. in length, 13-ft. high and 11-ft. wide, loaded upon a trailer some 60-ft. long. The difficulty has been overcome by utilising the company's train ferry *Essex Ferry*, which was designed to take rail vehicles to and from the Continent. The first of the aeroplanes will be shipped on November 3 and the second on November 6. The trailers will be run straight on to the deck and to complete the consignment, a 60-ft. trailer, loaded with equipment, and some 10 railway trucks containing aero engines and other material are to travel by the same ferry.

Future of the Derby Canal.

Derbyshire industrialists have expressed the opinion that the proposal to close the remaining portion of the Derby Canal is ill-timed, particularly having regard to the declared intention of the Trent Navigation Company to convert Nottingham into an inland port. Opposition to the Derby Canal Company's proposals has been taken on the grounds that the canal has served as a useful traffic route, and that its use should be considered in relation to any unified system that may be established under nationalisation.

Improvements at Uddevalla.

The Swedish Government has given the Uddevalla Council permission to carry out certain works in the harbour area, near the site of the new shipyard which is being established there. The new works include the construction of a quay about 230 metres long, and a pier about 150 metres long, and the dredging of about 14,000 cu. metres of material. The work is to be carried out as and when labour is available.

Port of Sunderland Improvement Schemes.

The Ministry of Transport has given authority to the River Wear Commission to commence work on ten schemes of harbour, dock and river improvement, estimated to cost £719,693. These schemes are part of the comprehensive proposals for the development of the Port of Sunderland submitted by the Commissioners several months ago, and estimated to cost more than £3,000,000. It is understood the Ministry is giving consideration to the Commissioners' application for Government grants towards the cost of the works, under the Distribution of Industry Act, 1945.

Rehabilitation of China's Fishing Industry.

Six deep-sea fishing vessels purchased in the United States have arrived in China. They are the first of hundreds to be brought to China under a programme organised by U.N.R.R.A. to rehabilitate the fishing industry. The vessels crossed the Pacific under their own power, manned by experienced American fishing crews, who will instruct the Chinese. Twenty-four other craft of the same type are en route. A further 50 vessels are being purchased in Australia, and another 100 will be built in the United States. The cost of the entire programme is estimated to amount to over £9,000,000.

New Irish Harbour Authorities.

It is reported that the Minister for Industry and Commerce, Eire, has completed the membership of the various harbour authorities which are reconstructed under the Harbours Act, 1946, and twenty-three of these new bodies held their first meetings during last month. The Act provides that the Minister shall nominate four members to each of the authorities at Dublin, Cork, Limerick and Waterford, and three members, one of whom must be representative of labour interests, to the other harbour authorities. In respect of 14 harbours no elections were held owing to the insufficiency of qualified electors and the Ministtr has accordingly appointed two members to each of these in place of elected members.

Danish Port Officials Visit United Kingdom Ports.

The Mayor and officials of the Port of Aarhus, Denmark, recently visited the Port of London where they made a detailed inspection of port equipment and discharging and loading facilities. The party then proceeded to the Port of Liverpool as guests of the Mersey Docks and Harbour Board, and carried out a tour of the Liverpool and Birkenhead docks. In an interview, Mr. Svend Larsen, the Mayor of Aarhus, referred to the improvement scheme, estimated to cost about £2,500,00, which his port had envisaged in 1939, but had been prevented from carrying out by the war. Now, he said, their plans were being delayed through a shortage of steel and iron for reinforced concrete, both of which they hoped to obtain from Britain.

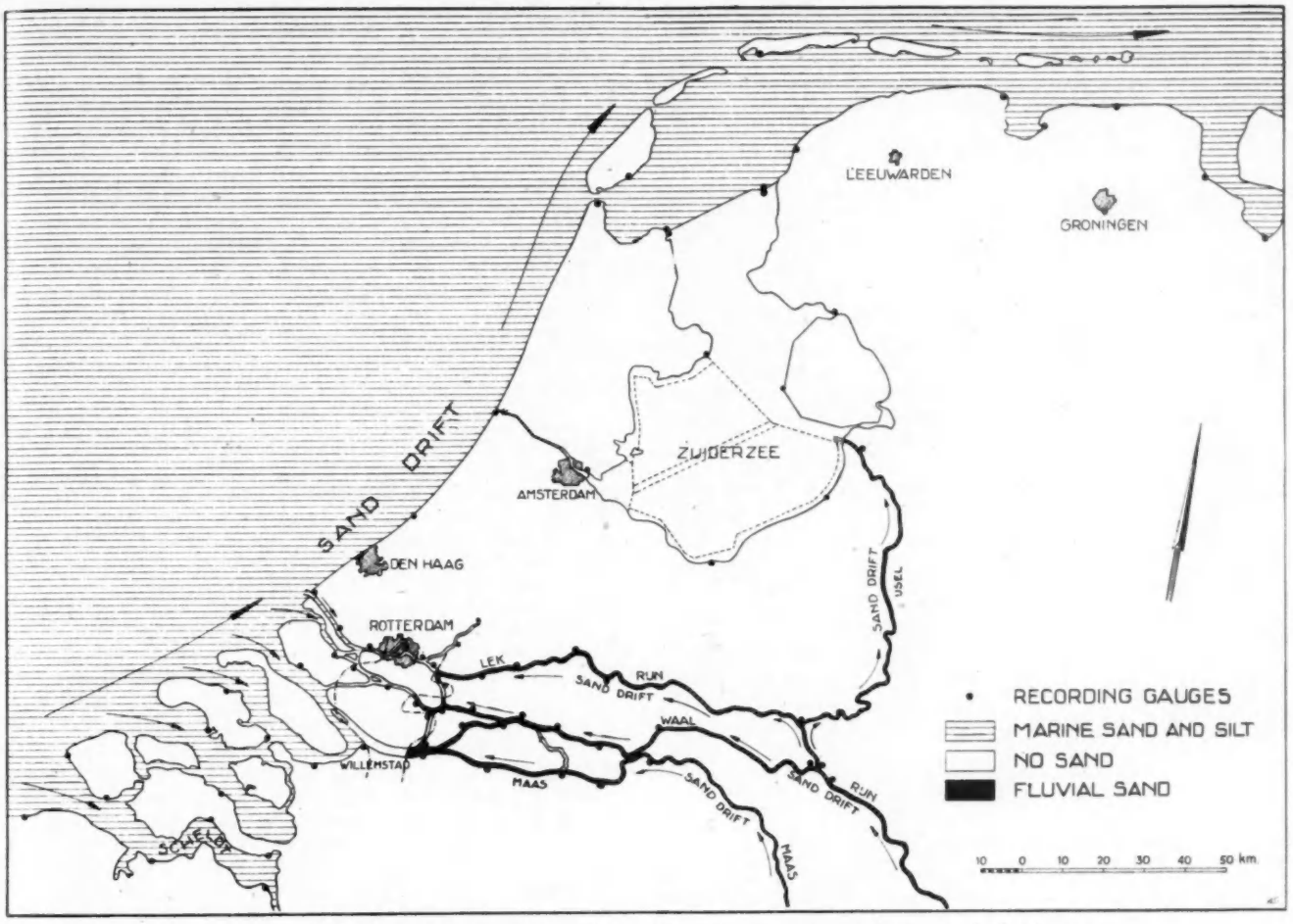


Fig. 1. Coast of the Netherlands showing position of Recording Gauges and the two main Sandstreams.

*Research of Tidal Rivers in the Netherlands**

A Successful Combination of Theory and Practice

By DR. J. VAN VEEN
Chief of the Tidal Research Department of the Rijkswaterstaat, Holland.

RESEARCH into water, sand and silt movements in tidal channels is necessary in order to deal with many engineering problems in an intelligent way. Ignorance is expensive and unsatisfactory. Laboratory tests are advisable, too, but even then the study of natural phenomena cannot be neglected. Not everything can be imitated in a laboratory, while in order to be able to imitate we first must know the conditions of nature exactly. The danger of waning trade due to the silting of harbours hardly exists to-day, because of the power of modern dredges, yet enormous amounts of capital are often required for dredging purposes. In Holland alone, about 30 million tons of silt must be removed annually, while many millions of guilders are wanted for the defence of a relatively short coast.

With those interests in view, research into problems of harbours, river mouths, tidal inlets and coasts seemed quite justified, and in 1930 a research bureau was established in order to make a thorough investigation of the tidal streams and coasts of the Netherlands. Dr. J. A. Ringers, then Director General of the Rijkswaterstaat, now Minister of Public Works, saw the necessity of possessing full information and a thorough knowledge of the natural forces and phenomena relating to our inlets, rivers and shores, in order to be able to make economical plans and provisions. His command was: " investigate everything "—a broad-minded attitude indeed.

Great value was attached to the investigation of the transport of solids by water. About this matter hardly anything was known. C. Lely, later famous for the plans to reclaim the Zuiderzee-bottom, had published a report on the transport of solids by the rivers Rhine and Maas as early as 1883-1887, but since then this good example had not been followed. Not before 1920 did the question come again into the foreground, when J. J. Canter Cremers took up the research of the Rotterdam Waterway with an instrument of his own design which, with modifications, is still in use. This clever investigator died soon afterwards in Egypt, while giving advice about the Nile.

Experience since 1930 has shown that theory and practice should not be separated. Practice needs theory (or research), and theory without practice is nothing but lame, academic knowledge. The activities of the research bureau—in which 50 to 60 persons are engaged—are along the following lines.

*Written in 1940, since then the survey-ships were destroyed by the Germans.

Research of Tidal Rivers in the Netherlands—continued

Natural Research.

This means the investigation of existing conditions. How are the currents in some estuary during a normal tide? How during springtides or storms? What is the influence of wave action? What are the natural laws governing the mechanics of that

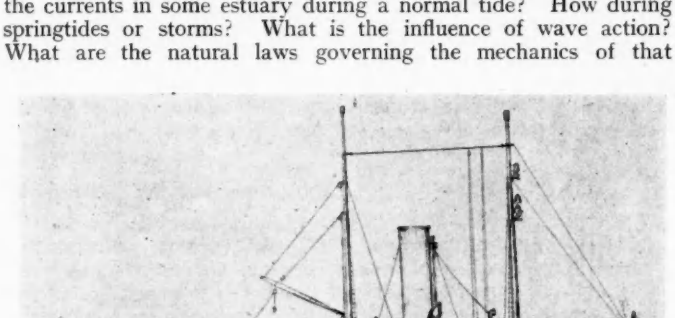


Fig. 2. Survey Ship *Ocean*.

estuary? What is the strength of the currents near the bottom and what direction have they? What is the location of the so-called sand streams and what is their magnitude? Can those sand streams be influenced in such a way that sand transportations diminish or cease to exist? Very often sand does not come from a river but with coastal drift. This marine or coastal sand penetrates into river-mouths because of undercurrents due to salinity. Therefore salinity differences must be studied with great care.

From these and other factors, it follows that the research of natural conditions asks for a well-equipped ship and much work and study. In the research bureau there are four parties working separately. One in the south (Scheldt); one along the coast; one in the Rhine-delta: and a fourth in the North (Waddenzee). The Dutch practice leads to research seasons of six months during the summer. For inlets of a medium size, say, 10 by 10 kilometres area, about 50 spots are chosen, in which measurements during 13 successive hours are taken at normal, neap and springtides. This means, at least, 150 measuring days per inlet of that size. In addition, measurement for a period of 16 successive days and nights is taken once or twice in every inlet in order to learn the fortnightly changes due to lunar influences.

Of course, the vertical tide has to be measured as accurately as the horizontal tide (another name for streams). The readings of the tide gauges at shore (see Fig. 1), which have given continuous records since about 1850 or 1870, are supplemented during the measurements with those of recording instruments for the vertical tide, placed in the sea and giving tidal curves of 16 days' length. Thus the tides and their propagation in front of the coast can be learned in an exact way. **An exact knowledge of the co-tidal lines is necessary, because they govern the tidal currents near the coasts and the inlets.**

Another branch of activity is to investigate the configuration and character of the bottom. Series of soundings have to be taken periodically, while bottom samples are thought to be necessary. With the aid of recording instruments, the phenomena which occur during storms are studied.

Historical Study.

The natural research described in 1, can only be temporary. Its' time dimension is generally not longer than 13 hours, or, in the case of the longer measurements, 16 days. Even this, comparatively, is very short. Because prediction of the future is wanted, a certain knowledge of the past is required. The inlets where the channels migrate periodically often show a cycle of 10, 20 or perhaps a 100 years. If works are to be carried out in such inlets, these migrations must be known thoroughly, and it is not possible to gain a complete knowledge of them in one or two years by natural research alone. Old charts, therefore, must be looked up in archives, and from these a so-called " film " must be composed. The scale of all charts making up this film and the level to which the depths relate should be the same. This question of level often causes some trouble when, in different periods, different levels have been used. Often the " films " do not reach very far back in history. In Holland the year 1800 is a fair limit. There exist remarkably fine charts of the 16th and 17th centuries, but these are not accurate in the modern sense. Between 1800 and 1900 the charts are infrequent. Recent ones are better. It is important to say that the old hydrographers were mainly after the shoalest spots, therefore they put too many figures of the extreme shoal sort on their charts. We need the exact natural shapes. Some of the inlets require sounding yearly, others even more frequently; while there are also some which change little.

Cubature.

From the old charts, profiles are taken and these are compared so that regions of silting and scouring can be spotted for the intervening periods. This is very important to know; the accuracy of the charts must be such that the cubatures may be trusted. The amount of sand coming into our channels or going out of them, and the periodicity or irregularity of its migration, can be learnt only in this way.

Geology.

This may seem to have only a faint relation with river improvement, but it has to be considered that our engineering works affect the geological or natural forces and are destined to function even in the remote future. The Netherlands are, from a geological point of view, a nascent country. Owing to sand coming from the southern shores, and due to the situation at the mouths of rivers—also bringing some silt and sand—stable con-

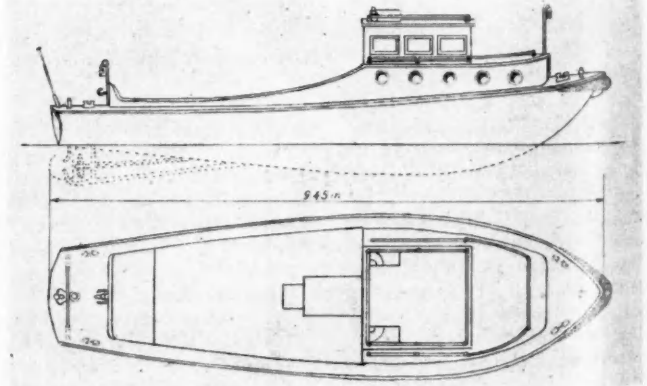


Fig. 3. Launch *Vlet*.

ditions cannot be expected. Research into the prevailing geological factors is therefore necessary. The amount of solids brought hither annually is only a few millions of tons by river and about the same amount by the coastal drift from the south-west. This may not be so very much, yet it accounts for the many " Villes mortes."

Research of Tidal Rivers in the Netherlands—continued

Observations at the Dutch tidal gauges show that the bottom subsides about ½-inch per 10 years, rather too much for a low country. We do not know as yet whether this is due to geological subsidence, to the melting of more ice in the world, or to ordinary mechanical settling of loose soil. The geological research of seas is still insufficiently developed. In order to know the spots near coasts and inlets which might be resistant to erosion, borings beneath the sea are being made.

Holland badly needs sand for improving the soil for building town enlargements and roads. The Rhine and Maas do not bring enough to satisfy these needs. Therefore the sand will have to be taken out of the sea, or from those spots which might be made deeper without damage to any other interests. Navigation gains by this costless dredging, but salinity becomes worse.

Mathematics.

Calculation cannot be dispensed with; it is quite necessary. Every new design carried out in some part of a system of tidal channels affects the tides in all of them. About 15 persons, under the direction of a doctor of mathematics, are constantly at work calculating with the aid of modern calculating machines how the tides are going to be in the future, when some plan of river improvement is to be executed. Each new open harbour, each deepening of some channel, each widening or narrowing of it, causes changes in the tides. The currents will increase or decrease, the amplitude of the vertical tide is likely to be affected, and the flow of the fresh water through the different channels will be altered. The magnitude of these changes must be known exactly beforehand.

Measurements taught us that the sand content in the water is proportional to the 3rd or 4th degree of the water velocity. The sand movement, therefore, is proportional to the 4th or 5th degree of the water velocity. If the original water velocity—taken as unity—is increased by 100%, the sand movement will then be proportional to 2^4x original water velocity. That is to say the original sand movement multiplied by 16. As mentioned, the sand movement may increase $2,^5$ equals 32 times. An increase in velocity, therefore, may cause severe scouring; a decrease may cause silting. Both silting and scouring are to be avoided if possible; scouring may cause land slides and it means silting elsewhere. The best thing one can wish, is a channel with no sand stream at all.

Of great importance are the calculations covering the expected storm floods. When, owing to the execution of new plans, a rise of the storm flood of only a few centimetres can be calculated, the result in most cases is a heightening of the embankments (dikes), and this entails vast expenses. The theory of the tides had to be developed in such a way that these accurate calculations became possible. For this reason, a very extensive series of total flow measurements in a great many channels has been performed in the years 1931-1936, the result being that the theoretical calculations now are about as accurate as the measurement of tidal currents and vertical tides. The formulae are complex and the solving of a problem for a net of 20 channels means the handling of 40 of those complex formulae.

Statistics.

Because of the long series of observation data, a statistical research is necessary. Statistical series are those of the lightships, where the velocity of the currents are taken every half-hour, day and night continuously. Results are to be compared with similar observations of neighbouring countries and with those of the past. In Amsterdam a long continuous series of data exists about the level of the sea from 1700 onwards. There are still other series which ask for statistical analysis. Often these studies lead to contact with meteorologists. With the statistics of storm surges must go the theory of probability.

Chemistry, Petrography, Botany.

In many harbours, not sand but silt must be dredged. We call silt the fraction of solids smaller than 20 micron. Silt content can be best estimated by comparing the sample in glass tubes with the " solutions " of known percentages of silt. The difficulty with silt is that it is so voluminous. Sometimes silt with as much as 80 per cent. of water content must be dredged away; therefore means are sought to condense it. The question: whence does the sand and silt come from? points in the direction of petrographical science, by which the heavy minerals (grains sinking in bromide) are determined. The different kinds of sand and silt should be known, in order to be able to draw correct conclusions as regards the places of origin.

The land reclaiming schemes, which go hand in hand with river improvements and coastal defence, demand chemistry, biology and bacteriology. For fertility the right combination of sand and silt must be brought to settlement—therefore the mechanical and biological processes which influence this fertility must be studied with care. Botany comes into the picture with the cultivation of *spartina-townsendii* and other marine plants fit to retain the silt on salt or brackish sand flats. Land gaining is one of the most fascinating jobs for a river engineer, but it asks for much research and many tests. Here a research bureau may accomplish its best results " making work with work "—normalising channels by making fertile land—using natural means.

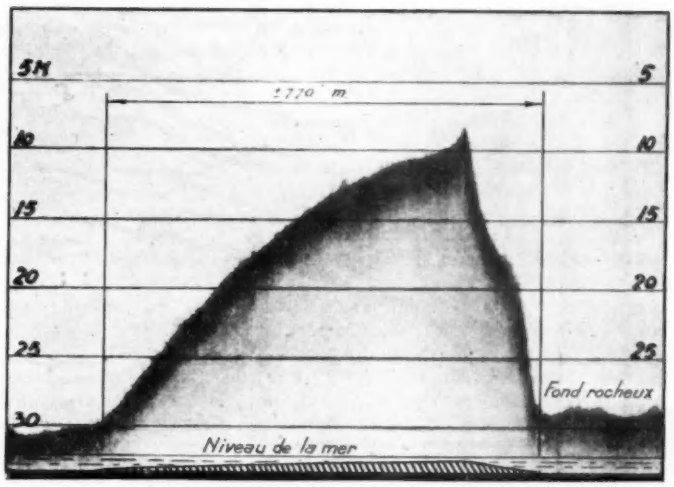


Fig. 4. Typical cross-section of Sandbank on Rock Bottom.

One of the most important questions where we touch the domain of agriculture again is the gradual salting of the low areas of Holland. With the water and the soil of those low areas only very slightly brackish, the agricultural and horticultural harvest shows a decrease. A normal horticultural harvest may be reduced by 50%, horses may fall ill, and cows may produce only a small quantity of milk. A salt percentage of no more than 200 milligram Cl per litre or less is not dangerous. 300 mg is the ultimate limit. The salinity must therefore not exceed that of ordinary drinking water.

It has been learned that open tidal harbours in the so-called brackish region silt up very quickly. They also have a great influence on the salting of the whole lower part of the river. This occurs because the heavy salt water gets into the harbour along the bottom and always carries much silt. It enters the harbour towards the end of the floodtide and leaves this basin near the end of the ebb. After that, the flood, coming again, takes this salt further up river. In a regularised river mouth with smooth borders, the salt does not come so far as in rivers with irregular borders or with many open harbours. Therefore no open harbours should be made in the brackish sections, and we should remember well that everywhere where a particle of salt water may come, a particle of sea silt may come also. Plans to provide all low areas of Holland with a constant stream of fresh Rhine water require many millions of pounds. The drainage of the Zuiderzee must be partly considered in that light, one of its main purposes being to create a fresh water basin in the heart of Holland.

Research of Tidal Rivers in the Netherlands—continued

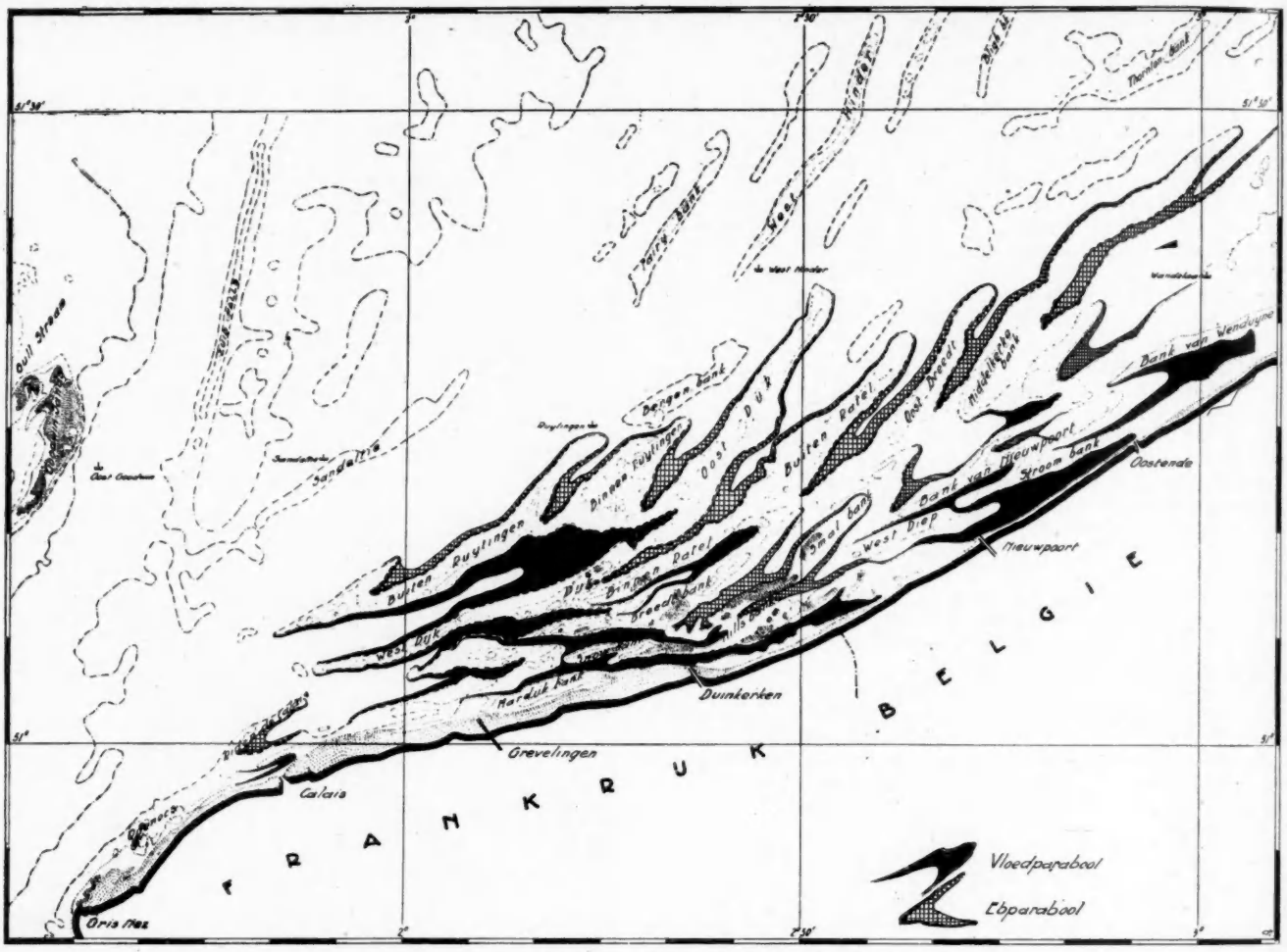


Fig. 5. Flood and Ebb Parabolas of the Flemish Banks.

Instruments.

These must be simple and they must give trustworthy data. Several instruments had to be evolved and had to go through their period of infantile diseases. Without the invention of new instruments, further discoveries are impossible, so new ones must be constantly tried, tested and simplified. For this purpose a small workshop, where new devices are being made or repaired, has been established. Those of the instruments which have stood the tests of practice for several years will be described hereafter.

Exploring Ships.

The largest vessel in use is a sea-going boat of 400 tons and 4 metre draught (Fig. 2). With this boat observations are being made during six months of the year. For the inlets, vessels of 20 to 60 tons are used. All ships possess a launch, shaped as indicated in Fig. 3. These launches are very seaworthy and are meant to assist the investigations. Mostly the bigger ship lies at anchor during a whole tide or during 16 successive days and then the launch (called " vlet ") can in the meantime explore the surroundings and keep contact with the shore. The launch should have an echo-sounder on board.

The ships should not sway while lying at anchor, or else they must have two or more anchors, which is a great nuisance.

Echo-Sounding.

Six instruments, system Hughes, are in use in order to investigate the bottom configuration and to provide regular sounding charts of the rivers and inlets. A description of this fine and accurate instrument is not necessary; sounding lead and rod are fairly well out of use nowadays. For the investigation of an inlet or a river, the echo-sounder is essential. By its use the regularity or irregularity of the bottom can be learned distinctly and quickly. In a preliminary way it shows where the bottom consists of sand, silt or rock. It is the " eye on the bottom " which we hydraulical engineers have been after since time immemorial, and which enables us to get an insight into the condition of the bed.

Remarkable light was thrown on the bottom conditions when going out of the harbour for the first time with the echo-sounder in 1933. We were quite surprised to find an endless series of beautiful *rhythmic waves* on the recording paper. These wave forms of the bottom were not then known. In the North Sea, in front of the Dutch coast, most of the crests reached a height of 10 metres above the troughs between them. They were gigantic ridges caused by the pendular movement of ebb and flood, standing perpendicular in the direction of the alternating water currents. These ridges may cause inconvenience to ships because they can shift easily. In ordinary rivers similar sand waves are found, but they are smaller there. At a mean depth of 5 metres, the height of the sand tops is often 80 to 100 centimetres, i.e., about 20%. A typical echo-record of a sand ridge is shown in Fig. 4.

The shape of the sand waves shows the direction in which the sand travels. When, for instance, the northern slope of the ridge is steepest the general direction of the sand stream is towards the north. If the shape of the sand wave is purely trochoidal and symmetrical, it can be deduced that there is a sand movement which is in equilibrium. In that case, there is a sand movement, but it has no forward resultant.

Research of Tidal Rivers in the Netherlands

(continued)

Another phenomenon which may be studied easily with the aid of the echo-sounder is the situation of ebb and flood channels. If there is a bar at the northern end of some channel, then the resulting sand stream is likely to go to the north. An example of the analysis of an area of ebb and flood channels is shown in Fig. 5 (the Flemish banks). The flood current from the Straits of Dover pushes into the channels near the coast and has scoured "flood channels" or "flood parabolas" there; the ebb current from the North Sea is prevailing in the northern domain of the banks and causes "ebb channels" or "ebb parabolas." In analysing sand bank complexes in this way, they begin to have a clear meaning to us. We must know the bottom of our waters as if it were the soil of our own garden. All forms of its sand-banks and bars must be familiar to us, so that we can detect even small changes immediately. Investigation with vlet (launch) equipped with an echo-sounder and with a bottom grab, and, in brackish water, an hydrometer, gives a good preliminary knowledge of the main points of any inlet.

For the determination of distances, range-finders of about one metre base, or sextants, are used. Range-finders are to be preferred to sextants when distances of less than 1,000 metres are concerned and alignment-sounding is carried out.

(To be continued)

Wellington Harbour Board, New Zealand

Excerpts from the Chairman's Address at the Sixty-fourth Annual Meeting held on 26th June, 1946

In moving the adoption of the Annual Report and Balance Sheet for the year ended 30th September, 1945, I would like briefly to comment on some of the salient features of the year's operations.

The trade of the Port showed a considerable decrease last year both in regard to tonnage passing over the wharves and in shipping arrivals. This is attributed to largely by the heavy falling-off in our imports from overseas, particularly from the United Kingdom. During the first four years of the war (1940-44) there was a steady increase in overseas import tonnages handled at the Port, but with the war moving to its end, particularly in the Pacific, the diminution of the flow of war materials and equipment last year revealed the extent to which overseas imports for industrial and commercial uses had been reduced.

The total cargo handled through the Port showed a decrease of 23.7 per cent., the actual tonnage of 1,916,335 tons being the lowest since 1935.

British and Foreign imports decreased by 36.8 per cent. and Australian imports by 28.2 per cent., while coastal imports, which have been well maintained over the war years, increased by 0.4 per cent. The total decrease in all classes of imports was 19.1 per cent.

Taking the trade of the Port on a Customs value basis, it is interesting to note that for the last year over 41 per cent. of the total imports and 30 per cent. of the total exports of New Zealand passed through the Port of Wellington. These percentages of total trade, when compared with pre-war figures, show a small increase which is due mainly to the centralisation of shipping, but the figures are an indication of the importance of the Port of Wellington in the trade of this Dominion.

The financial figures reflect the comparatively low level of port trade, and the income of the Board was reduced by £156,099 whilst the expenditure, including the customary transfers to Special Funds, dropped by only £51,190. The loss on working was £143,941 which, added to the deficit of £38,632 in the previous year, makes a loss of over £182,000 for the past two years.

The rapid deterioration in the finances of the Board during the past year, gave justifiable concern to members of the Board, and the position was constantly under careful consideration. Having in mind the fact that the Board's work is not profit-making undertaking, and that the Board has an obligation under statute to provide services and facilities for the efficient operation of the Port, it was indeed disappointing to learn that, as a result of an application made to it in July, 1945, for authority to increase the Board's charges, the Price Tribunal had decided to defer the request until 1st October, 1946, when the position was to be again considered, leave being reserved for an earlier hearing in the event of a further adverse change in the Board's position warranting such a course. Subsequent to the hearing of the Board's application, further increases in wages (retrospective to 1st April, 1945) were granted by the Court of Arbitration and the Waterfront Control Commission to the Board's staff and waterside workers respectively, and involved a further heavy increase in the Board's expenditure.

At the end of the financial year withdrawals from the Special Reserve Fund to meet expenditure amounted to £50,000, and as the Board could see no prospect of a reduction in the heavy daily loss on working then being incurred—particularly as its charges, based on 1937 levels, were entirely inadequate to meet the operating costs of 1945—the application was renewed in November last and resulted in authority being granted for the Board to increase its dues and charges by a surcharge of 30 per centum.

This increase, which became effective as from 1st January, 1946, is considered to be insufficient for the Board's requirements, without taking into account the fact that within the next two or three years the expenditure that will be necessary for deferred repairs and maintenance is estimated to cost £152,700, against which the special fund established for this purpose amounts to only £60,362, leaving an additional £92,338 a portion of which will have to be found from revenue. While it is extremely difficult to forecast the volume of trade that might be expected to pass through the Port in the next year or two, it seems certain that with the Government's policy of import selection some considerable time must elapse before the levels of pre-war overseas import tonnages are again reached.

The conditions appertaining to the employment of labour on the wharves are by no means constant, and it must be borne in mind that requests for new Awards for employees of the Board, and systems of contract work, appear to have the objective of increased proposals designed to alter the methods of cargo-handling under remuneration for service. With the Board's charges subject to Governmental approval, it is more than ever important to emphasise that proposals that would increase expenditure, must be given serious consideration as to their effect on the economic working of the Board's wharfinger system.

War-Time Services of the Port

The past year was marked by success to the Allied arms in the victorious end of the war against the Axis Powers, and the dark clouds that threatened the progress of humanity have disappeared in the effulgence of the dawn of world peace. In New Zealand's contribution to the prosecution of the war we are justly proud of the achievements of the members of our armed forces. A glorious page has also been written in the annals of the mercantile marine, and the fortitude and courage displayed by those who were associated with the steady flow of vital goods to and from our shores is, I am sure, acknowledged with gratitude and admiration by the people of this Dominion.

I think it is appropriate at this time to refer to the significant position of the Port of Wellington, more particularly in the war now ended. The far-seeing policy of past administrators of the Port in providing adequate and up-to-date facilities for shipping and the handling of goods, proved to be of immeasurable value in meeting the heavily increased demand for services to shipping, and in the handling of the large volume of war materials landed and shipped, particularly by the United States Government. The Aotea Quay Breastwork, which had been completed to meet the future requirements of the Port, proved to be of exceptional importance as a berth for American shipping, and also provided an extensive concrete-surfaced area for the storage of military equipment. The Board was pleased to be able to make this area available free of rent, and a rebate of 25 per cent. was also allowed on all dues on transports and their cargoes.

The Floating Dock, which was installed in 1931 as an added facility for shipping, was also found to be of inestimable value to

Wellington Harbour Board, New Zealand—continued

allied shipping and was a decided asset of national importance. In the six years prior to the war 146 vessels made use of the dock, compared with 302 vessels during the six years of the war, the increase in dockings, which included a large number of vessels damaged in war service, being 106 per cent.

The adequacy and efficiency of the cargo-handling facilities provided by the Board was amply demonstrated in the long period of continuous working of vessels, and the state of preparedness of the Port, which had resulted from the foresight of past Boards, did much to assist in the quick turn-round of shipping so vitally necessary in the period of national emergency.

Future Plans

The Port Development Committee has met a Committee of the City Council with a view to discussing the reconstruction of Jervois Quay Breastwork and Stores in conjunction with the widening of Jervois Quay by the City Council. Finality has not yet been reached in this regard, but when agreement has been arrived at, it will take about a year to prepare the plans for the reconstruction and a further four years to complete the work. The existing Store No. 39, a timber structure built during the 1914-18 war, needs replacement now that it no longer affords adequate protection for cargo. However, I see no reason why development of the Port should not proceed along Aotea Quay Breastwork north of Shed No. 49. The development of the Breastwork should commence with Store No. 51 as soon as the stores that were constructed by the Government have been demolished. In implementing its plan for the development of the Port, the Board will be faced with the necessity of borrowing monies in order to carry out the works contemplated.

The Board's £850,000 loan matures on 28th August, 1946, and provided the outlook in regard to the availabiliy of labour and materials is more favourable than at present, the raising of a further loan for a sum to be determined by the Board might well be undertaken at that time, in order to coincide with the maturity of the £850,000 loan and thereby avoid, as far as possible, any undue disturbance of the Board's present commitments for interest and sinking fund charges.

The rapid development that has taken place in regard to aerial transport, particularly in trans-ocean flight, must be considered in any developmental work contemplated by the Board. There appears to be a divergence of expert opinion as to the type of aircraft that will eventually be adopted for ocean crossing and, in view of the extensive use made of the flying-boat and the advance in its carrying capacity during the war, the possibility of a base for flying-boats being established at Wellington must be kept in mind. The Board has, on several occasions in past years, received favourable reports as to the suitability of Wellington as a base for flying boats, and expert opinion has been given that Wellington Harbour offers eminently suitable landing and take-off reaches and sheltered base waters. The commercial importance of Wellington, and its geographical position as a centre from which every portion of this Dominion could be rapidly served by means of road, rail and steamer service, commend the claims of the Capital City as the logical terminal for a point of distribution of mails and passengers.

In view, therefore, of the possible future requirements of this form of air service, any major work of development at Evans Bay will be designed to allow for the installation of facilities that might be required for flying boats.

The Port of Rotterdam

Some Post-War Impressions by a Visitor

At the beginning of October I visited the Port of Rotterdam, sailing from London in a cargo steamer carrying wool, barrels of New Zealand pelts, spring mattresses of the hospital bed type, some wall board and a few cases of soap for the Army. From the Thames Estuary to the entrance to the New Waterway there is a mine-swept channel, two miles wide, which is buoyed throughout its length. In fact, from London to Rotterdam, a distance of approximately 180 miles, there stretches a highway marked out with Trinity House buoys at intervals of approximately five miles and all except two of them are lighted. The impression one gets from the bridge during the hours of darkness is of travelling along a great arterial road.

The New Waterway Pilot joined the ship off the Hook of Holland and thence to the docks there is a broad channel some 18 miles long, with a depth of 36-ft. at low water and 41-ft. at high water, leading to the docks. Some miles up the Waterway the Germans had obstructed the port by sinking ships across the channel, but some of these have been raised leaving sufficient room for a large ship to pass. In fact the Pilot told me that the previous ship he had brought up was a tanker drawing 33-ft. A wrecked Hamburg-America liner stood high out of the water, but will be raised and salvaged in due course.

The ship in which I was travelling berthed in the Merwehaven and just short of the entrance a tug came alongside and we were boarded by the Dock Pilot while the tug passed a tow rope to the stern of our ship. The quay at which we berthed was wide and well-equipped with 3-ton electric cranes beneath which the railway lines pass. Spacious transit sheds run parallel to the quay. Across the dock a large pile-drived was engaged driving in concrete piles preparatory to rebuilding a quay demolished by the Germans. It should be mentioned in passing that there are no lock gates in Rotterdam as the range of tide is only about 5-ft. We were alongside by 8 a.m. and the dockers made an immediate start on discharging the cargo. They worked well.

I had been invited by the Stichsting Havenblagen to visit the Port of Rotterdam and was attached to a French Delegation which was in Holland in connection with negotiating a Franco-Dutch Commercial Treaty. Accompanied by the President of the Port of Rotterdam we embarked in the official launch *Stradrotterdam* for a cruise through the Port. We inspected most of the harbour area, and I was particularly impressed by the width of the basins and the large number of dolphins and buoys available for ships discharging, loading, or lying up. Even the buoy for swinging ships for compass adjustment is within the protected area of the Waalhaven basin. As was to be expected, there was a great deal of inland water traffic trading as far up the Rhine as Basle, Diesel barges carrying as much as 2,000 tons.

The amount of destruction wrought by the Germans is appalling, amounting to about one-third of the port. Quays, warehouses, bridges and cranes had been ruthlessly destroyed. Deep water quayage had been reduced by 7.3 kilometres and the quays for river vessels by 5.9 kilometres, a total of approximately 10 miles of lineal quayage. Warehousing space is at present about 70% of the pre-war capacity while tankage accommodation for mineral and vegetable oils has been reduced to 65%. There are at present 195 quay cranes compared with 282 in 1940, and 60 floating cranes compared with 80 in 1940. Eleven of the 16 floating docks existing before the war are still in commission. The quay cranes vary from 3 tons to 8 tons capacity, a large number of them having a radius of from 100-118-ft.. There are, in addition, heavy quay cranes up to 30 tons capacity with a maximum reach of 34-ft. There are 29 floating grain elevators with a capacity varying from 150 to 250 tons an hour, and in addition there are 9 quay elevators. Present storage accommodation includes 3,900,000 sq. ft. of shed and warehouse storage, two cold stores with a capacity of over 1,000,000 cub. ft. and five granaries with storage accommodation for 125,000 tons. In the petroleum dock the present storage accommodation amounts to 625,000 tons compared with 900,000 tons before the war. The jetties and pumping installations in this dock were undamaged and the refinery and cracking plant is again in working condition.

Repair work is well in hand: quays are being rebuilt, damaged warehouses are under reconstruction, dredging is in progress and the spoil is being pumped ashore for land reclamation in the various polders.

Altogether, my impression was that the Port of Rotterdam was making good headway with the work of reconstruction.

Elbe Open for Navigation.

Navigation on the Elbe between the British and Soviet Zones of Germany was resumed on 3rd October last, when the first craft were ready at Hanover and Berlin.

Design and Construction of a 2,000-ton Slipway

By J. S. YOUNG, B.Sc., B.Eng., M.Inst.E.Aust.*

General Description of Slipway

In 1938, proposals were made for the construction of a new and larger slipway at Fremantle, the existing one on the north side being in bad condition and limited to 850 tons.

Owing to the restricted area of the harbour and proposals for future harbour extension, the possible sites were limited, and the site chosen at Arthur's Head on the south side was the best possible, but is not quite free from rough weather conditions and a cross ebb during winter floods.

The capacity of the slipway was fixed at 2,000 tons, and authority to proceed with construction was given in September, 1940.

The original proposal was for a slipway 740-ft. long, with telescopic cradle 190-250-ft. long, with draft of 10-ft. over keel blocks at forward end of cradle. Of this length, 460-ft. were below L.W. and 280-ft. above. The normal tidal variation is very small, and L.W. datum is taken for the necessary drafts.

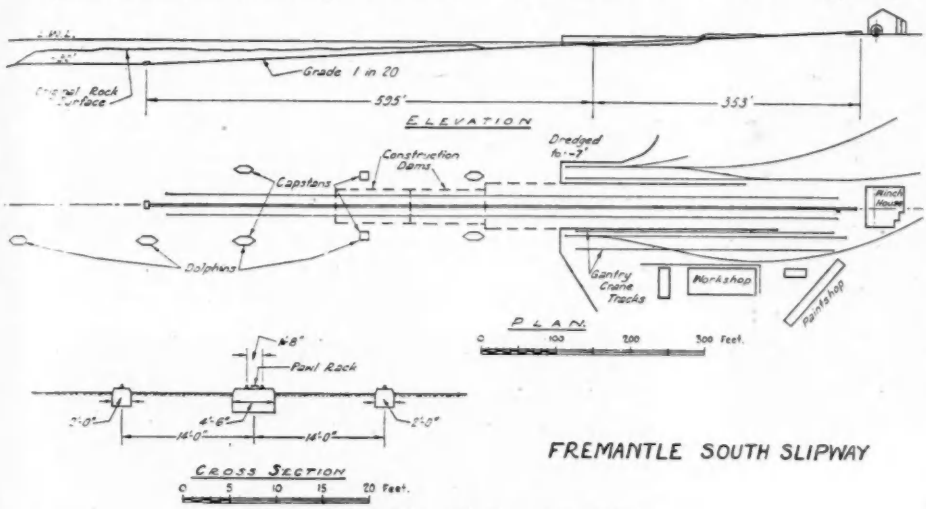


Fig. 1.—Sketch Plan and Elevation of Slipway.

During construction, in order to accommodate certain naval vessels, a request was made for the draft to be increased to 17-ft. at a distance of 76-ft. from the forward end of cradle, or 13-ft. 9-in. on the forward blocks, which entailed an extension of the ways below water for a distance of 135-ft., and at the same time the shore endways above water were extended 73-ft. to enable longer vessels to be accommodated, as service vessels are generally longer than merchant vessels of equal tonnages. The overall length is now 948-ft., 595-ft. being below water, with the outer end at a rail level of 29-ft. 9-in. below L.W. At the same time, the length of cradle was increased so that a maximum length of 300-ft. was obtainable, but at present the cradle is 289-ft. long over keel blocks. A grade of 1 in 20 was fixed for the incline of the ways, which consist of two centre rails 1-ft. 8-in. centre to centre, with cast steel pawl rack between, and two single side rails, the centre of each being 14-ft. from the centre line of slipway. The rails are a special flat-bottomed section, 112 lbs. per lin. yd., 4-in. high, with a web 1½-in. thick, and are fixed on special cast iron chairs set at 2-ft. 6-in. centres, which also take the rail joints, a lug being cast on one side to hold the bottom flange, and a ⅝-in. clamp plate held down by two 1-in. bolts on the other. The cast steel pawl rack has vertical teeth 2-in. high, 6-in. pitch, and extends from 338ft. 6-in. below L.W. to 330-ft. above L.W. The pawl rack sections are 7-ft. 6-in. long, each held down by four pairs of 1-in. rag bolts.

The maximum load on the foundations of centre way is 4 tons per sq. ft., and bearing tests which were carried out on the rock on the foreshore were satisfactory, giving 6 tons per sq. ft. without settlement. The foundations, which are concrete throughout, are on rock, one section of 100-ft. mentioned later, where rock was shattered, being piled. The width of centre way foundation is 4-ft. 6-in., and the side ways 2-ft., the chairs, pawl racks, and their holding down bolts were concreted *in situ*. In order to maintain the thread and nut of these bolts from corrosion, and facilitate replacement of rails when required, a domed cap was welded on the top of the nut and the thread and inside of cap nut were coated with No. 3 Resqu steel paint, the outside of rails, plates, etc., being painted with No. 2 Resqu steel paint. To prevent creep in the rails, lugs were welded to the underside of the rail at the upper end of slipway and grouted up, the concrete being flush with the rail throughout. A stop for end of cradle is fixed at the bottom end of the slipway to prevent the cradle running off the rails, and this is combined with the foundations for the pulleys for downhaul rope.

Cradle

The cradle consists of seven carriage sections, with five inserts on centre way only; the five middle carriage sections mount the bilge arms which carry the sliding bilge blocks (fifteen on each side), four extra bilge arms being fitted later to two of the inserts. The bilge blocks are fitted with pawl racks. The carriage sections are coupled together by drawbar links secured by placing special alloy steel pins, 5-in. diameter, through the centre girder.

There are 430 rollers under the centre girders and 146 rollers under side girders, a total of 576. The rollers are of cast steel, 9-in. diam. on the tread, with single flanges of 12-in. diam. and 4-in. diam. axles. Those under centre girders are 4½-in. wide on tread, and under side way girders 3½-in. wide. Each carriage section is fitted with a pawl.

The centre of the carriage was designed to take the whole load at a maximum load concentration of 16 tons per lin. ft., and the sides to take 20 per cent. each.

Axle bearings are cast iron, with G.M. bushes and grease lubrication, the underside having a felt pad to keep grease on the axle and prevent sand and grit adhering to it.

Steel ploughs to clear the rails of silt or obstruction are fitted at the lower end of the mid and side girders, with ¼-in. clearance above rails.

The distribution of the pressure of a ship's keel over the blocks is a very complex problem. The length of overhang of some vessels causes concentrated loads, and at the initial slipping stages concentrated loads at the forward end of keel are exerted until the whole of the keel is seated on the blocks. These areas of concentrated loads on the cradle vary with various vessels. One vessel recently slipped was 345-ft. long, having 212-ft. straight keel with 60-ft. overhang forward and 73-ft. overhang aft.

The keel blocks which are 15-in. square karri timber, at 2-ft. centres where the major loads are anticipated, have been cribbed up on timber bearers to a grade of either 1 in 50 or 1 in 96, depending on the length of keel of vessel, so that the keel sits throughout with the minimum amount of forward movement of the cradle, and therefore minimum time and reduced stresses. This and other alterations have increased the weight of cradle from the original design of 143 tons to 290 tons.

*Paper read before the Perth Division of the Institution of Engineers, Australia, and reproduced by permission.

The author is Engineer for Harbours and Rivers, Public Works Department, Western Australia.

Design and Construction of a 2,000-ton Slipway—continued

Construction

Dredging.—From L.W. the natural surface approximated to the grade of the slipway for a distance of 150-ft.; thereafter the rock had to be dredged out, being 12-ft. 6-in. deep at the end of original design, but 16-ft. at the end of the extension. This rock was drilled and blasted at 5-ft. centres over a width of 50-ft., and 25,434 cu. yd. of rock were dredged out; the upper section in shallow water was removed by floating grab dredge and punts, and where there was flotation, by bucket dredger.

Fig. 2.—View looking West, Showing Cradle and Dolphins.

A start was made by constructing a timber gantry, 300-ft. long, to carry a crane track to a point 150-ft. beyond L.W. mark. This was to give access for the construction of a coffer dam, 200-ft. by 45-ft. wide, divided into two equal sections, so that the upper length of the ways could be constructed in the dry, thereby assuring better foundations over the length where the heavier loads would be carried.

The dam was constructed of steel sheet interlocking piling which was driven to a minimum of 6-ft. into the rock, strutted internally with timbers that were also secured to timber piling which carried the gantry forward over the work. This sheeting proved very effective for the walls of the dam, but the water making through the rock bottom was greater than anticipated. This was due to the presence of pipes of limestone and veins in the rock, carrying large quantities of water often with sand in suspension, and it was found necessary several times to allow the water to level up, and then to grout the pipes by tremie, allowing time for the concrete to set before pumping out again. Two centrifugal pumps, 15-in. diam., were necessary to cope with the water. The first upper 100-ft. of the dam was pumped out and concrete ways laid, complete with chairs, pawl rack, and rails. This was allowed to flood and the second section then pumped out, after which excavation and concreting of the ways proceeded, but a few days before completion, and after work in this section had been carried on for a period of seven weeks, the dam collapsed.

It is considered that the rock bed was weakened through the sand being washed out of the veins in the rock, and that the weaker portions of rock were then lifted due to the hydrostatic head. There were areas of softer and laminated rock, but no evidence of cavernous areas. The collapse lifted the ways already concreted and shattered the rock foundations to such an extent that it was decided to reconstruct this section by working under water. After clearing the bottom, probes were put down to ascertain the depth of shattered rock; timber bearing piles were then driven under the line of the ways to solid rock. Precast concrete casings, 5-ft. 7-in. x 5-ft. 3-in. x 1-ft. 6-in. for centre way, and 7-ft. 7-in. x 5-ft. 3-in. x 1-ft. 6-in. for side ways, with 4-in. thick walls, were then placed over a group of four piles at 15-ft. centres, and after being levelled up were concreted through tremie pipe to graded level for seating of reinforced concrete precast beams. The beams were complete with chairs for rails and, where required, pawl racks, which were accurately lined and levelled; the beam for centre way was 2-ft. 11-in. x 1-ft. 3-in. section, and side way 1-ft. 6-in. (top) x 2-ft. 3-in. (bottom) x 1-ft. 3-in. (deep) section, both 14-ft. 11½-in. long with the ends tongued and grooved. After final levelling the spaces between foundation blocks were shuttered, and concreting by tremie was completed, forming the foundation from the intermediate timber piles to the reinforced concrete beam.

The outer ends of the ways, including the extension, were constructed in a similar manner without piling, the casings being set on the dredged rock bed. The casings, which were 5-ft. x 3-ft. 9-in. x 1-ft. 6-in. for centre ways and 3-ft. 9-in. x 3-ft. 6-in. x 1-ft. 6-in. for side ways, were set at 10-ft. centres, and the reinforced concrete beams were 2-ft. 8-in. x 1-ft. 3-in. section for centre, and 1-ft. 6-in. x 1-ft. 3-in. for side way, 20-ft. long, the bottom centre way beam having a buffer stop 2-ft. high, cast intregal to take the end of cradle.

During this outer construction, as the steel sheet piling was drawn it was re-driven, forming a dam between the first section completed and the shore, the inshore ends remaining to form the retaining walls of the ground carrying the crane tracks on either side; these walls were 60-ft. apart and were considered ample for the beam of any vessel using the slip, at the same time allowing the cranes available to operate.

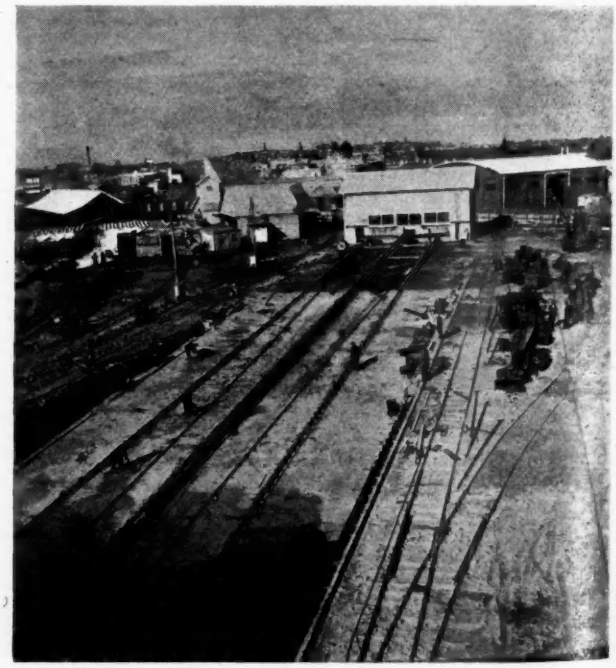


Fig. 3.—View looking East, showing Tracks and Winch House.

Haulage.—Haulage is by a direct pull on a double drum, the bight of the rope passing round a cast steel pulley, 6-ft. in diam., attached to the leading end of the cradle. The ends are secured to the two helically grooved drums (right and left-hand) round which the rope is wound. A third drum takes the down-haul rope which passes round twin cast steel pulleys, a 2-ft. diam. at 2-ft. 10-in. centres, securely mounted on a block at the extreme lower end of centre way. The main hauling steel wire rope is

Design and Construction of a 2,000-ton Slipway

(continued)

10½-in. in circumference, 1,400-ft. long, the down-haul wire being 4-in. circumference.

The haulage winch is electrically driven by two motors of 125 h.p. at 775 r.p.m., fitted with solenoid brakes.

The first reduction is by double helical machined teeth with a ratio of 1 : 6.95, the pinion being forged steel and the wheel cast steel. The second reduction is straight spur cast steel machined teeth with ratios of 1 : 3 and 1 : 6, the two pinions being on a sliding keyway to provide haulage speeds of 20 and 10-ft. per minute, as required. The third reduction is straight spur cast steel (ratio 1 : 6), and the fourth reduction to drive on drum is also straight spur cast steel with ratio of 1 : 5.88; the final pinion is also on sliding keyway. Clutches are provided, of the two-jaw type, to couple down-haul drum to the main haulage drums, and also for the cross drive.

Dolphins

Timber piled dolphins, three on north side and three on south side, are provided for centering the vessel on the cradle, the outer two on each side being fitted with electric capstans; there are also two guide dolphins on the south side for vessels to lie against before warping onto the slipway.

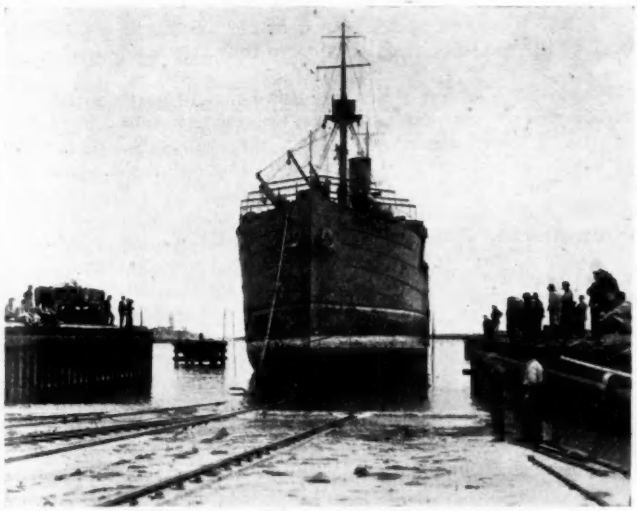


Fig. 4.—First Vessel to use Slipway—"S.S. Chungking." (Gross 1,967 tons, 285-ft. long, 44-ft. beam.)

Services

On the south side an electric travelling gantry crane is provided, capable of lifting 6 tons at 46-ft. radius, and placing load on the deck of a vessel on the slip. A 5-ton steam travelling crane is located on the north side.

For vessels requiring electricity for lighting, ventilating, refrigeration and cooking, a direct current generator is installed in the winch house, capable of supplying 500 amp. at 110 or 220 volts. In addition, points are provided on each side of slipway for portable lights, and also for plugging in welding sets or electric tools.

An air compressor, of 300 cu. ft. capacity at 100 lb. per sq. in. pressure, supplies air to four double points on either side.

Three fire hydrants are fixed on each side, and three triple connections for flooding chambers on vessels, if required.

Small stores and workshop are erected on the south side, with paint stores and paint mixing room. Lavatories and showers are available for crews living on board vessels.

The slipway was first used on 22nd September, 1942, and in a period of three years* has accommodated 282 vessels of an aggregate tonnage of 343,691.

*Figures as published here have been adjusted since presentation of the paper.

Port of London Authority

Excerpts from Thirty-seventh Annual Report

TRADE OF THE PORT

The total net register tonnage of vessels that arrived and departed with cargoes and in ballast from and to British Countries and Foreign Countries and Coastwise, excluding naval vessels and vessels with naval crews requisitioned or chartered for naval or military transport service, but including vessels on Government service with mercantile crews even if engaged on operational duties, during the twelve months ended 31st March, 1937-1946, was as follows:—

	Tons		Tons
1937 ...	61,796,515	1942 ...	17,529,591
1938 ...	62,949,744	1943 ...	14,665,170
1939 ...	62,085,840	1944 ...	18,703,909
1940 ...	46,070,103	1945 ...	33,353,992
1941	20,114,208	1946 ...	31,017,310

The net register tonnage of shipping that used the wet dock premises of the Authority during the twelve months ended 31st March, 1946, 1945 and 1939 respectively was as follows:—

	1946	1945	1939
Foreign and Coastwise (Inwards and Outwards)	*19,573,192	*29,702,150	34,713,344

*Includes vessels engaged on operational traffic and naval vessels, etc., on which dock dues were paid.

The shipping entering the Dry Docks of the Authority during the twelve months was 1,891,472 tons gross, compared with 1,649,952 tons gross in the previous year and 3,077,170 tons gross during the year ended 31st March, 1939.

The tonnages of goods landed or received by the Authority for warehousing or immediate delivery or for export during each of the years ended 31st March, 1946, 1945 and 1939 were as follows:—

	Imports. Tons.	Exports. Tons.
1946	*1,621,315	*1,277,732
1945	*1,353,272	*2,704,330
1939	2,091,032	744,625

*Includes operational traffic.

Finance

The Capital Expenditure for the year ended 31st March, 1946, amounted to £232,838, the principal items being:—

	£
Cranes and locomotives	180,989
Land	20,073
Construction of new quay, sheds, etc., North Side, Royal Victoria Dock	16,133

The following is a summary of the year's working:—

	£
Total Revenue	7,599,872
Total Expenditure	4,862,284
Balance of Revenue	2,737,588
Deduct—Items appearing in Net Revenue Account No. 8, *e.g.*, Interest on Port Stock, Stock (Redemption) Fund charges, Income Tax., etc. ...	2,717,890
Balance (Surplus) for the year	19,698
Balance (Deficit) brought forward from 31st March, 1945	572,152
Leaving to be carried forward a deficit of ...	£552,454

The expenditure during the year on account of the General Fund for the Maintenance and Renewal of Premises and Plant and for Dredging was £8,173, and, after transferring £700,000 from Net Revenue Account, the balance standing to the credit of the Fund at 31st March, 1946, was £1,307,541 of which £430,277 is invested.

Port of London Authority—continued

GENERAL

Hostilities with Germany and Japan ceased during the early part of the year under review and the new conditions were reflected in the trade of the Port by a diminution in the volume of military traffic and an increase in commercial cargoes, especially of exports. Some of the commercial shipping which for security reasons was diverted elsewhere during the war has already returned to the Port of London, although at the end of the year the tonnage entering and leaving London was only about one-half of the 1939 figures.

The transition period has brought with it many difficulties in meeting the demands made upon the Authority by the users of the Port. In most instances it has been possible to make at least temporary arrangements to meet the most pressing demands on the available deep-water berthage accommodation and it was not practicable to meet the requests of many shipowners who wished to resume occupation of the particular berths occupied by them before the war as being the most suitable for their business. Continued representations to the Government led to improvement in this respect by the end of the year, and notwithstanding the general shortage of storage space throughout the country some progress has been made in the release for normal traffic of transit sheds, warehouses and open sites.

The London Port Emergency Committee was dissolved on the 24th February, 1946, on the lapsing of the "Control of Traffic at Ports Order, 1939." Having regard to the likely continuance of abnormal trading conditions for a time, arrangements were made to extend, voluntarily, the co-ordinating machinery which had been set up under the Port Emergency Committee during such period of transition as was necessary.

War Damage.—Towards the end of 1945, a Committee consisting of representatives of the Government and the Dock and Harbour Authorities' Association was set up for the purpose of ascertaining and recommending to the Minister of Transport and to members of the dock and harbour group respectively, the total amount of war damage sustained by the group and the basis of appointment between members of the war damage contributions to be paid by the group to the Government. The Authority's Chief Accountant has been appointed Chairman of the Committee.

Works.—The Authority's engineering programme has been mainly concerned with the restoration of the cargo-handling facilities at the docks involving general repair of war damage, the reinstatement of transit sheds, erection of temporary storage facilities, etc. Efforts to this end have been seriously hampered by the shortage of building labour, while repairs to mechanical plant have been delayed by reason of the contractors for this work being extensively committed to ship repair work in the Port.

The Authority viewed this position with considerable apprehension and strong representations were made to the Ministry of Transport with the object of obtaining a considerable increase in the labour force available for essential reconstruction work.

Consideration has been given in detail to the arrears of maintenance and dredging work which have accumulated during the war period and as a first step to reduce these arrears a programme of high priority works has been approved involving expenditure approaching £500,000.

To meet urgent requirements the purchase and erection of prefabricated structures for use as storage and transit sheds was authorised and the erection of two large transit sheds, one at Surrey Commercial Dock and the other at Millwall Dock and of several storage sheds has been completed.

War damage repairs to several sheds and warehouses throughout the docks were completed during the year and permanent repairs to some of the damaged quays, etc., were carried out.

At the request of the Ministry of Transport and in connection with the use of investment by public utility undertakings as an instrument of the Government's employment policy, the Authority have supplied to the Ministry a programme of capital and maintenance works (including restoration of war damage) which it was anticipated would be undertaken in 1946. The programme represented considerably less than is required to be carried out during the year, but account had to be taken of the availability of materials and labour. The expenditure covered by this programme was estimated at £1,995,000.

Dredging.—During the year 768,109 cub. yds. of material were dredged from the river and 1,593,884 cub. yds. of mud from the docks. The deposit of this material in the river at Mucking Bight continued throughout the year.

With a view to overtaking the arrears of dredging accumulated during the war, the Authority decided to resume as soon as arrangements could be made the pre-war practice of employing certain dredging plant on double shift working.

Marine Salvage—The agreement entered into with the Admiralty in 1940 in respect of salvage work within the Port and Thames Estuary has continued to operate throughout the year, a revised agreement being under negotiation at the close of the year.

During the year, three ships with a gross registered tonnage of 19,242 tons were raised and major assistance rendered to three damaged vessels of a total gross tonnage of 19,652 tons. In addition, 39 small craft (barges, etc.), were raised in the river and 21 in the docks.

The Authority viewed with concern the position that might arise in the navigation of the lower reaches of the river from the presence of a number of wrecks in or near the recognised navigable channels, when routeing instructions cease to be issued by the Naval authorities and representations were made to the Admiralty with a view to more salvage craft being allocated to the Authority's management for the purpose of facilitating the removal of the obstructions. The Authority have under consideration arrangements for safeguarding the interests of navigation in that area while the obstructions remain.

The general question of the liability of the Authority arising from the presence of obstructions caused by enemy action and mines in the area of their jurisdiction and in the approaches to the Port, which also affects Port Authorities throughout the United Kingdom, is under discussion with the Ministry by the Dock and Harbour Authorities' Association.

Reconstruction Schemes.—At the request of the Westminster City Council, the Authority have submitted observations so far as their interests are affected on the scheme for the replanning of the Pimlico district. Proposals for the re-development of Gravesend have also been examined.

Consideration has been given to the Greater London Plan, 1944, prepared by Sir Patrick Abercrombie, and further observations have been submitted to the London County Council on the report of their Town Planning Committee on the County of London Plan, 1943.

The Report is signed by Sir John Anderson (Chairman) and F. W. Nunneley (Secretary).

Tyne Improvement Commission

Retirement of Two Officials

Mr. R. F. Hindmarsh, chief engineer to the Tyne Improvement Commission, is to retire in February next, and **Commander W. W. C. Frith,** harbour master, is to retire in January. The Commissioners have appointed Mr. A. L. Harvey, now chief assistant engineer, to succeed Mr. Hindmarsh, and deputy harbour master Captain C. W. Blaylock to succeed Commander Frith.

Mr. Hindmarsh, who has had nearly 50 years' service with the Commission, commenced his duties in the engineer's department and later became resident engineer at Tyne Piers depot and chief assistant engineer. He was appointed chief engineer 31 years ago, and since then has been responsible for several important river and dock improvement schemes, including the widening of the river in the reaches below Newcastle. He has also been responsible for major developments at Tyne Dock. These include construction of a new quay inside the dock and improvements to coal staiths. He will continue to be associated with the Commissioners in an advisory capacity.

Commander Frith commenced his career in sail over 50 years ago, and saw considerable sea service before taking up duty with the Commissioners, in whose service he has spent some 40 years. He has carried out the duties of harbour master in two wars.

Use of the Cement Gun in Maritime Operations

Cement-Gun Repairs to Maritime Reinforced Concrete Structures, with Special Reference to the Town Quay, Southampton*

By JOHN PERCIVAL MASTERMAN PANNELL, M.B.E.,
Assoc. M. Inst. C.E.

(Continued from page 147)

Discussion

Mr. H. D. Morgan observed that he was particularly interested in the work described in the Paper because he had had some experience of similar work which had been carried out by Sir William Halcrow about 15 years ago on the Whitehead Torpedo Company's firing range at Portland Harbour. Water had penetrated the concrete columns and considerable corrosion of the bars had occurred, whilst the concrete had been split off in all directions and many of the links had to be replaced before the guniting was done.

Recently he had had an opportunity of inspecting a reinforced concrete pier constructed by the late Mr. C. S. Meik in 1904, which was a very early date for reinforced concrete, and had found it to be in remarkably good condition. A brown line was showing here and there in the columns, in line with some of the bars, and when that occurred the practice was to cut the part out and make good. The pier had been very well maintained, and remarkably few of the columns had had to be treated. It had to carry greater loads than formerly, as heavier cranes were being used, and small modifications had been made in order to strengthen the deck, but the original columns had not been altered.

With regard to guniting beams, Mr. Morgan considered that one could not hope to restore bond by applying gunite, and surely successful results from the point of view of development of stress, could be expected only when—as was usual—the bars were well anchored. When they were lapped over the supports they could still be effective, but the kind of adhesion that was obtained in a normal reinforced concrete beam could not be restored. The factor that made repair possible was that, as a rule, the bars were well hooked deep into the concrete, where that kind of damage did not take place.

He wished also to refer to a jetty, at Alderney, on concrete cylinders, which had been constructed in about 1906 by a person whom he could only describe as an enthusiastic amateur and who had seen reinforced concrete construction, but was rather a business man than an engineer, and had built a jetty in order to export stone from the island. Although the island contained some of the finest stone in the world for aggregate, yet the whole of the concrete had the texture of a slight sponge cake. It could be penetrated by water anywhere, and at every beam and column it had been split off and was lying about on the ground. No concrete was left covering a bar, except just over the columns, where it had been deeply buried. That jetty was an extraordinary sight and formed a complete contrast to the pier built by Mr. Meik, where there had been proper supervision of the type of concrete and of the cover.

He agreed with the Author's view that for sea structures 2-in. of cover should be provided; and even then the concrete work should be very well supervised.

Mr. Jack Duvivier observed that he had been very interested to hear Mr. Morgan's harrowing story of the Alderney jetty, because it had been his experience that enthusiastic amateurs, when constructing reinforced concrete structures, invariably buried their reinforcement on the neutral axis. That was a very good idea from the point of view of cover, because it gave the maximum, and he was surprised at the condition of the Alderney jetty.

In watching the slides shown by the Author, he had been struck by the horrible condition into which reinforced concrete could get when it had been subjected to tidal action over a period of years. When the engineer inspected the structure shown in the slides, he must have found it very difficult to decide whether to pull it down and start again or to undertake some other form of treatment.

In 1937 or 1938 Mr. Duvivier's firm had been requested by the Newlyn Harbour Commissioners to report on the reinforced concrete quay which had been constructed in about 1906 or 1907 along the north pier. It was an interesting structure, and he believed it was one of the first reinforced concrete structures built in Great Britain. The Commissioners had taken rather a gloomy view of the situation and had asked for an estimate of the cost of filling the structure solid. As that estimate amounted to about £23,000, the possibility of repairing the quay by gunite was investigated, and a contract was made for encasing the whole of the underside of the decking with gunite. The work was done in the summer months—the most suitable time for marine work. The decking consisted of cross deck beams with slabs spanning the spaces between the beams, surfaced with granite sets. Gunite 1¾-in. thick was applied. The sand was a mixture of equal volumes of ⅛-in. Penlee chippings, 1/16-in. downwards Penlee crushed grit, and some Falmouth sand. The proportion passing a standard sieve with 50 meshes per linear inch was less than 20 per cent. The work comprised 4,800 super feet of 1¾-in. reinforced gunite, and also involved the construction of about 70 new raking members, consisting of 6-in. by 3½-in. steel channels totally encased in 1½-in. of reinforced gunite, with a few repairs to the solid masonry pier. The total cost was about £930. The surface finish was the natural characteristic gunite finish and it was not touched by a trowel. Light timber shooting strips were fixed along the corners of all the beams, to assist in obtaining reasonably true lines to the finished work. The reinforcement consisted of square-mesh 8-gauge-diameter rods at 3-in. apart centre to centre in both directions, and rustless "Crapo" wire was used for the binding. The fabric was supported by means of Rawlplugs drilled into the concrete at 3-ft. centres in both directions. Mr. Duvivier had not seen the work since its completion about 8 years ago, but he had been informed that it was in as good condition now as when it was carried out.

He hoped that in the course of the discussion some information would be forthcoming with regard to the encasement of greenheart or jarrah piles with gunite. His firm had been faced with a good deal of that kind of work in the maintenance of rather old timber structures in which the timber had been very severely attacked by *limnoria*, particularly around the bolt-holes, which invariably became enlarged and allowed the *limnoria* to get down between the bolts and the timber, rendering maintenance very difficult. The usual practice, when dealing with small jobs, was to encase the joints in mass concrete; but in the case of a timber jetty of any size it was well worth while to encase the joints and the main body of the piles in gunite; and he would welcome any information in regard to carrying out such encasement of timber.

He questioned whether reinforced concrete structures exposed to maritime conditions should ever be allowed to get into the condition of the Southampton quay and the other structures illustrated by the Author's slides. In the early days of reinforced concrete it used to be said that the material was practically permanent, and he supposed that was true to some extent, inas-

*Paper read before the Maritime and Waterways Division of the Institution of Civil Engineers and reproduced by permission.

Use of the Cement Gun in Maritime Operations—continued

much as if a structure was built up of pre-cast members made under controlled conditions and vibrated, so that it was possible to maintain the correct amount of cover and spacing and a sufficiently dense concrete, the structure would probably require no maintenance at all. On the other hand, it was a lamentable fact that the bulk of reinforced concrete structures which were built *in situ* between tides began to deteriorate after a few years. What usually happened was that binding wire was left projecting through the side of the member and insufficient cover was main- between the reinforcement and the side of the mould, and sometimes there was insufficient tamping. The result was that usually after about 9 or 10 years extensive maintenance work had to be carried out.

It was the duty of his firm to maintain a number of old reinforced concrete structures for the Royal National Lifeboat Institution, some of which had been in existence for 30 years or even longer. Those structures were visited and examined every third year, and it was usually found that some of the beams were beginning to show signs of splitting—generally longitudinal cracks along the line of the main reinforcing rods, and rust spots. The rust spots were cut out and the cracks opened out to a sufficient depth to enable a fairly stiff mortar to be trowelled in and pointed up. That kept the structures in a reasonably good condition, and no major gunite repairs had been necessary so far. Admittedly some of the structures were found to have deteriorated so badly that it was necessary to break away the concrete from the bottom of some of the beams. In that case the whole of the concrete was cleared away to some little distance behind the main reinforcement the rust was chipped away, and the base of the member was completely remoulded. In the past, a method of coating reinforced concrete, by applying a mixture of sal-ferricite and aluminous cement had been tried. The mixture was in the form of a paste and was brushed on to the reinforced concrete. Mr. Duvivier had visited a number of structures which had been treated in that way and had found that the mixture acted as a very valuable coating, which prevented moisture attacking a member and causing it to deteriorate. The specification was as follows: " The concrete to be thoroughly cleansed and damped down with water. Apply with a stock brush a slurry composed of 3 parts of *ciment fondu* and 1 part of sal-ferricite by volume, plus sufficient water to form a creamy mix. This gauging should be evenly and thickly brushed over the concrete, taking precautions to see that the material is well stirred during its use so as to prevent any settlement occurring."

Mr. J. E. Goode observed that concrete was not foolproof. Ninety-nine per cent. of it was permanent, and it was only the remainder that gave trouble to engineers.

He was interested in the reasons suggested for the failures that had occurred, including electrolysis, which apparently occurred whether the concrete was wet or dry or alternately wet and dry. He had had experience in India, Europe and America, as well as in Great Britain, and he had found that in all cases the deterioration occurred between high and low water. Could the Author explain how the electrolysis took place, or its effect in comparison with that of salt water penetrating to the steel rusting it, the steel then drying out, and then salt water penetrating again?

In Mr. Goode's experience lack of sufficient cover did not apply except in the case of the stirrups, which were usually put on the outside. Owing to insufficient cover, they deteriorated and rusted and burst away the concrete; but the main bars were nearly always behind the stirrups. He considered that most failures were due to porous concrete, insufficient tamping, or trying to get the concrete in too wet.

In his opinion, 1½-in. of gunite on an overhead surface was too much; ¾-in. should be used on overhead surfaces and up to 2-in. on vertical surfaces.

The encasement of wood piles in gunite had been adopted extensively on the Pacific Coast of America. In many cases the piles were covered with gunite before they were driven. It was then necessary to adopt a method of lifting them up without cracking, the gunite, but no damage was done in driving them.

Mr. S. C. Carter observed that it was not clear whether the Author invariably removed all the concrete from behind the reinforcement or if he sometimes gunited with, say, half the rod exposed. It appeared to be rather risky to apply a covering over only half the bar, because the adherence of the gunite material would not be so good. Had the Author ever confined the gunite to part of the surface of the rod and not placed it right round.

Fig. 13 showed a section of a pile. It appeared to be rather drastic treatment to beat off the initial rust with a heavy sledge-hammer, especially because there was always a tendency for the bar to bend slightly and to crush the concrete on side (a) rather badly and to leave a gap on side (b); moreover, the use of a heavy sledge-hammer might cause minute cracks at (c), which would never be filled by gunite. Similar remarks applied to beating off damaged concrete with a sledge-hammer. That treatment was too drastic, because it might bruise the surface of the concrete into cracks so fine that the concrete did not come away, but through which moisture would percolate in years to come and corrosion continue.

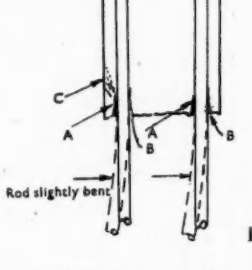


Fig. 13.

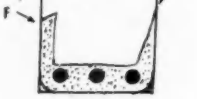


Fig. 14.

The Author had referred to flaky edges such as those shown in Fig. 14. They always presented difficulties, because there was a tendency for the gunite to crack again on the plane (e). From experience of all kinds of masonry repairs, Mr. Carter would never expect gunite to stay on a thin wedge. He suggested that it was best to cut in with a dove-tail formation (f), so that the new material had a key. It was true that, in the case of a large reinforced concrete structure, that would involve much work; but he would, at all events, endeavour to cut a square. The work should be finished with some kind of a key, even if only rough-cut. Admittedly that was very expensive, but he would consider it worth while.

The work at Southampton had been done by direct labour, but such repairs were very often carried out by a specialist firm. Such firms did wonderful work and they had considerable experience, but he thought that they had a tendency, on account of that experience, to lay down the law on how the work should be carried out, whereas a contractor, doing a straight job on drawings and specifications, would be less inclined to dogmatize. The engineer in charge of the job and responsible for the expenditure, should know in his own mind exactly how far he would let the contractor go—in other words, what he would allow and what he would not allow. In work of the kind in question, the engineer should not be guided entirely by the experience of a firm, but should have his own views on the matter.

Mr. A. Jackson observed that the success of the remedial treatment in question depended principally on two operations, namely, the fixing of the reinforcement and the application of the gunite. The former was often regarded as a minor operation, but it was really one of the most important. Whereas the Author had relied on fixing the reinforcement, in the case of piles, to the corner bars, Mr. Jackson considered that it was better to fix the reinforcement to the face of the piles. Wherever the gunite was applied, the force of its application produced a rebound effect, which had a tendency to lift the reinforcement back towards the face of the gunite, and there was a danger of that happening in the case of a 16-in. pile which had reinforcement fixed only at the corners. Moreover, when the gunite was applied, again there was a tendency for the binding wire to be " lifted " out towards the face of the surface coat of the gunite, which eventually caused

Use of the Cement Gun in Maritime Operations—continued

rust spots. The use of a rustless wire for binding would save much trouble.

With regard to the shooting strips, he considered that the right course to adopt was to put light shooting strips at the corners of the beam. For instance, it was possible to put two light shooting strips at each corner, fixed on to the existing bars; to shoot in between them and obtain the thickness without any fear of rebound; and then to remove the strips and complete the operation round the sides and the corners. Especially in the case of a pile, shooting strips were useful from the point of view of cover. The cover could not be tested by taking the depth of the original surface, because at that particular portion of the pile the deteriorated concrete had been cut away and, wherever the trial was taken, the depth behind the original structure was unknown. Therefore, it was much better to bring the whole thing out to the dimensions that one knew were covering the corners. Without shooting strips the only satisfactory method was to stop work and cut the gunite out while it was still unset and re-shoot it. The shooting strips did not affect the question of rebound, and they gave a very pleasing effect; the structure might look even better than in its original form.

With regard to rust spots appearing after guniting, cutting out and reshooting was feasible, but it was very difficult. Mr. Jackson had tried many times to cut out a 2-ft. square panel with a 1-in. rendering of gunite. It was a very hard dense material, and an attempt to cut it out invariably shattered the surrounding material and cracked it. If one cut out a small rust spot, one got rebound into it when one re-shot it. The Author said that the gunite process lent itself to easy repairs, but Mr. Jackson thought the process should be carried out in such a way that repairs were not necessary.

With regard to the repair of timber piles by guniting, his firm had had considerable experience of that at Blyth and Plymouth. The Blyth job was a very straightforward one. They had used 1½-in. of gunite with very light mesh tacked to the timber and had gone down to within 1-ft. of low water. There was very little, if any, wave action, and the method proved to be very much more economical than the shuttering and pouring which had been used before. He had seen the work six years after it had been done, and it was then in good condition. The timber pile jetty at Plymouth was rather different. It was very much decayed, so extra reinforcement was introduced, and gunite was used successfully. He thought there was very great scope for gunite work in the protection of timber jetties.

He agreed with the Author that gunite repairs should be examined and reported on and all the data obtained, because if they were to be a success it was necessary to have experience on which one could depend.

Mr. G. M. Treharne Rees observed that gunite had been used during the construction of two of the large "Phœnix" units of the Mulberry Harbour. The two units had been built in the Dockyard at Portsmouth, and Sir William Halcrow & Partners had been the Consulting Engineers. Concrete of insufficient soundness was found near the bottom of the swim ends, and it was decided to cut those out. The concrete was in the sloping portion, which was leaning at an angle of 30 degrees to the horizontal, so that the work was not easy. It was all overhead work to replace the concrete. The areas were extensive, and it was found necessary to cut 13-in. into the work when cutting out. In some cases the areas extended behind the second row of reinforcing bars. Gunite was applied and the whole of the damage was made good. The maximum thickness of layers that could be applied were used; in fact, the gun continued to be used until each layer more or less flowed. That had to be done, because it was necessary to adhere to a time programme. In order to ensure that the gunite which had been applied in such thick layers was satisfactory, four sets of cubes were made, with three cubes in each set. Each cube box was placed on its side and half filled with gunite making a 3-in. layer in the bottom of the box. That was allowed a few hours to set, and then the rest of the cube was filled in an upright position. When they were crushed at 4 days the four cubes showed an average strength of 3,677 lbs. per square in., indicating that the strength was sufficient. In order to test the bond between the concrete and the gunite, one cube was half-filled with 4-to-1 concrete from the unit and left for three days to set. Then after the surface had been just scratched over, the cube was filled with gunite and was left for 4 days to set. The cube was then crushed and showed a strength of 2,800 lbs. per sq. in. It was interesting to watch the crushing. The concrete, which had been maturing for 7 days was observed to crush before failure appeared in the gunite. The cube was crushed on its side and no failure appeared at the junction of the two materials.

After using the extreme thicknesses of gunite and watching it carefully, he agreed with the Author that not more than 2-in. should be applied at a time. He would prefer 1-in. or 1½-in., but in the case to which he had referred the work had to be done against time and the maximum permissible thickness was applied.

Had the author any details of the test cube which showed a compressive strength of 10,000 lbs. per sq. in. at 7 days? That strength seemed to him rather extraordinary, and he would like to know whether the conditions were special. Obviously it was a laboratory specimen; he considered that test cubes should be taken under the conditions under which the work was carried out.

Further, had the Author any figures in connection with the waste of material in applying gunite. In the case to which Mr. Rees had referred the gunite was applied in an overhead position and when the work was finished a large quantity of gunite aggregate—at least 30 per cent., and perhaps 50 per cent.—appeared to have rebounded from the work on to the floor of the dock. The quantity was difficult to judge owing to broken concrete from the faulty work also lying on the floor.

The Author had stated that dry sand was not essential; but unless the nozzleman was extremely skilful the sand should be very nearly dry, because the slightest excess of moisture in the sand made a great deal of difference with regard to the adherence of the material.

Mr. G. E. Scott observed that it was often said that engineers learned more from their failures than from their successes. Many engineers had avoided the use of reinforced concrete in salt water, but the introduction of gunite had brought to light a method of repairing the defects which occurred when reinforced concrete was used in salt water. In his own limited experience of sea-water structures he had had several cases of bad failure of reinforced concrete, not only in the tropics in sea-water, where conditions seemed to be especially bad, but also in bridges over brackish tidal creeks. The failure of reinforced concrete appeared to be due, as had already been mentioned, to electrical currents, possibly caused by the action of the salt water on the iron. That was surely a matter for chemical investigation. He believed that the Sea Action Committee of The Institution had had the subject under consideration to some extent, but no Report had been issued by that Committee for some time.

Had the health of the men working the nozzles been affected in any way? Silicosis occurred in various other trades, and it seemed possible that the workmen using the nozzles might be liable to be affected by the combination of cement and sand.

When structural members of reinforced concrete were practically dismantled and reconstructed with gunite, the strength might be considerably affected; had the Author carried out any tests on the strength of such members after they had been repaired?

Mr. A. G. Orr-Ewing observed that, with one small exception in Italy during the war, the works upon which he had used the cement gun had not been connected with maritime structures.

The job on which he had had occasion to make the greatest use of gunite was the construction of underground oil-fuel storage reservoirs. The internal face of one long reservoir had been entirely lined with gunite, in order to render the original concrete lining even more impervious to the seepage of Diesel oil which it eventually held, and in all the remaining reservoirs of the installation the construction joints had been given a sealing of gunite.

The Author had stated—and most users of gunite would agree—that absolute dryness of the sand was not essential; but in practice, it seemed rather dangerous to allow that impression to gain ground, particularly where the sand was being supplied on

Use of the Cement Gun in Maritime Operations—continued

site by someone who was not connected with the gunite company. The tendency was then to assume that the dryness of the sand did not matter at all, with the result that choking occurred in the gun-to-nozzle tubes, especially if the lead was more than 100-ft. and if the lifts were high. In the case of the underground oil fuel storage reservoirs to which he had referred, the lifts were high, because the reservoirs were 30-ft. high to springing of the roof arching, with a further 15-ft. approximately to the soffit. He considered that it would be better to insist on a limiting moisture content for the sand, and to fix that limit so that no loss of cement would occur during the processes of mixing and placing the sand and aggregate into the machine.

What grading of the sand used at Southampton had been found to give the best results? The sieve analysis of the sand used on the reservoirs was as follows:—

Size of sieve ...	...	$\frac{3}{16}$	$\frac{1}{8}$	$\frac{1}{16}$	30	50	100	F.M.
Percentage retained	...	Nil	5·9	23·97	60·3	92·5	98·7	2·82

It was observed, however, when shift to shift sieve analyses were taken, that the best compaction and the least rebound were obtained when the sand content was mainly $\frac{1}{8}$ and 1/16, and eventually stock-piles of sand of that size was brought in and added to the incoming sand as found necessary. The grading of the sand as finally used was as follows:—

Size of sieve ...	...	$\frac{3}{16}$	$\frac{1}{8}$	$\frac{1}{16}$	30	50	100	F.M.
Percentage retained	...	0·6	16	43·8	60·3	92·5	98·0	3·00

Mr. Orr-Ewing considered that the preparation of the parent face was one of the most important parts of the operation of guniting. At Southampton the preparatory work had not, apparently, involved the cutting of many chases which were narrow in comparison with their depth, so that pehaps the formation of pockets, due to the whirl or the eddy of the sand in such confined spaces, had not constituted a major problem. In the storage reservoirs, where many thousands of feet of construction joints were sealed, The formation of pockets due to the rebound had certainly constituted a problem, and it had been found that, unless the chases were splay sectioned with all angles rounded, pockets were liable to form. The use of dovetailed cuts, or of right-angled cuts with sharp edges, was therefore carefully avoided. In the case of the reservoir which was lined throughout with gunite, the entire internal face was scarified to a depth of 1-in. and was then cleaned with an air-and-water jet, and the reinforcement, which was of exactly the same gauge and mesh as that used by the Author at Southampton, was then slung on the dowel-pins let into the concrete and fixed at about $\frac{1}{2}$-in. from the parent face, so that when the gunite was applied its building up forced the reinforcement out to approximately 1-in. from the finished face of the gunite. No sand pockets were found even when the gunite was sounded or when parts were cut away for observation.

With regard to finishing of the day's work, Mr. Orr-Ewing's practice had been to finish to a feathered edge and then to cut away that edge to give a depth of about $\frac{1}{2}$-in., but he regarded that as rather wasteful. Had the Author found that a satisfactory bond could be obtained by building up a feathered intermediate finish.

(To be continued)

Estuarial Management

Some Notes on Modern Practice

By CAPTAIN E. C. SHANKLAND
River Superintendent (1922-1943) to the Port of London Authority.

What is an Estuary? There are several definitions, probably the most acceptable being the mouth of a river where it broadens out to merge with the sea. Another description is: that part of the river penetrated by tidal influence—which may cover many miles landward from the coast line.

In either case, where navigability is an issue, there must be management—estuarial management of a high order—when vessels and cargoes require to be handled with despatch as befits modern times.

The diversity of conditions can be observed in comparing the estuary of the St. Lawrence, on the banks of which stand the majestic cities of Quebec and Montreal (the precise situation of Montreal is at the confluence of the Ottawa and St. Lawrence Rivers), and the Hugli, where Calcutta, bathed in tropical sunshine, functions as the seaport of Bengal, and which is open to navigation the year round, while the seaward reaches of the St. Lawrence are frozen and beset with ice for several months of the year.

Exponents of regional geography sometimes describe these seaport cities as Bridge Ports, places where the population has settled around a river crossing and established a bridge with roads radiating from the nucleus. A considerable number of these bridge ports are a hundred miles or more from the coast line, and their growth even in our time has been slow, when measured by the tempo at which we live. The Port of London was referred to by Tacitus (circa A.D. 55-130) as a City Port—Augusta—the superlative of Roman recognition. Thus, with the exception of temporary war-time seaports, e.g., Richborough, Kent, in the 1914-1918 war, and many similar ports of the 1939-45 war, the commercial trading seaport is not a mushroom affair, and does not rise like the modern airport in a matter of months. Among the restraining elements which guide the hand of administration is that of financial control. The types of finance are diverse.

From the point of view of the Ship, which includes the invested interest in the vessel—ship management and insurance—and consequently the Shipmaster, who, even when the vessel is under pilotage, has his responsibilities, the technicalities may be stated as follows:

Pilotage

This in itself is frequently older than the seaport. Time was when the obscure anchorage, with scant habitations nearby, could not be approached without that local knowledge which only fishermen pilots who knew the inner channels could provide. Pilotage organisation may be part of seaport management nowadays. It is always part of the estuarial management. The pilot's status varies in different maritime countries. He is a licensed man in the British Islands, deriving his authority, powers and limitations from a Pilotage Act.

Buoyage and Sea Marks

Endeavours have been made to establish some common form of sea marks under International Conference which would be acceptable to all seafaring countries. Some measure of agreement had been reached before World War No. 2, but ratification remains among the many incomplete tasks of the maritime nations. The size of buoys and types of light have been greatly improved since the advent of steam navigation. It is not necessary here to give technical details of the advances. Control of the coastwise buoyage system is generally under the national authority, whereas the marking of the waters reserved to port management is a local matter and associated with the marking of wrecks and obstructions —which implies serious local liability.

Wreck Marking

Liability to mark wrecks and obstructions which may suddenly become a menace to navigation is accompanied by the duty to advise pilots and mariners of these dangers. Port authorities are regarded under law as inviting vessels to use the seaport and its channels. Therefore, as invitors, they have obligations to mark, notify and remove dangers to the navigation in a suitable manner. Estuaries are localities where shipping converges and navigation may be dependent on issues of tidal urgency. Ships entering a port to dock at high tide will meet those leaving dock. This makes congestion at times in narrow waters and requires vision in the Bye-laws. Arising from faulty wreck marking, a port authority was obliged to meet heavy assessed damages on being sued by shipping companies. This occurred towards the end of the 1914-1918 war.

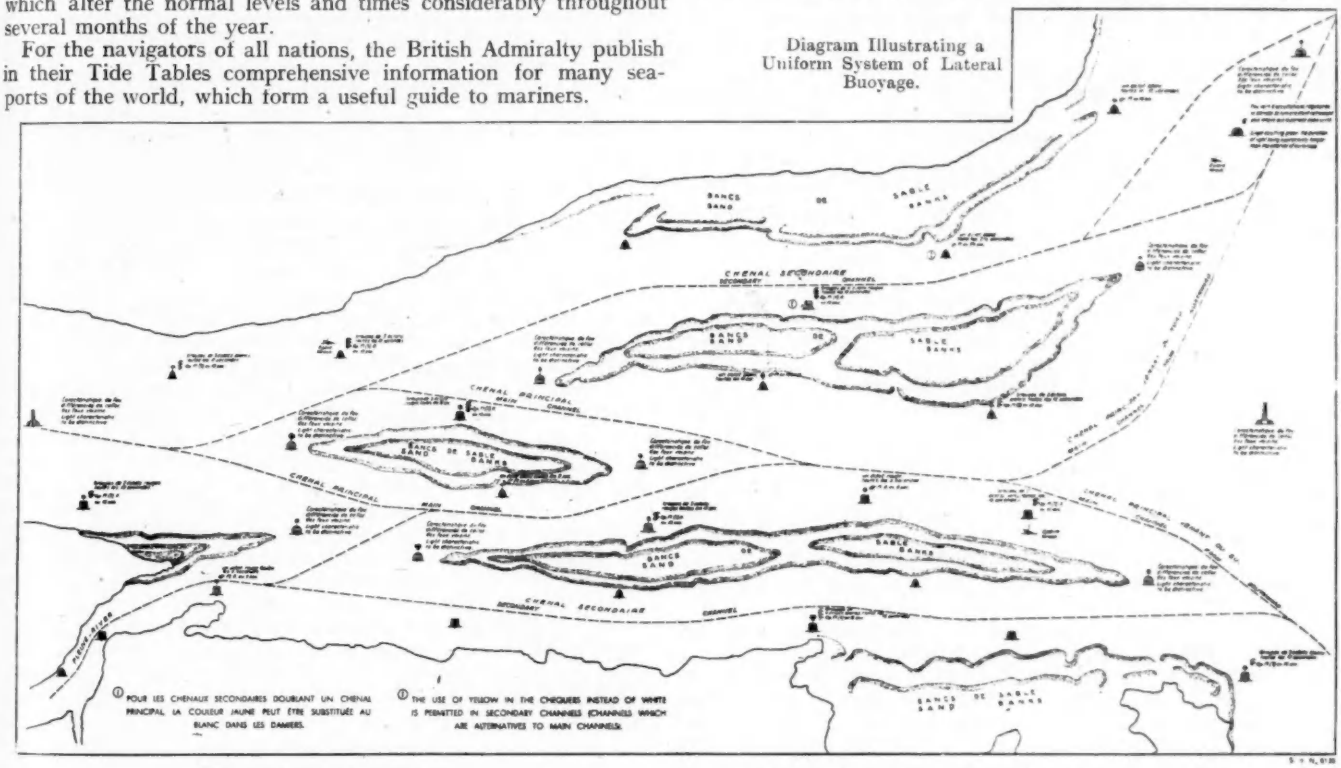
Estuarial Management—continued

The Tides

Among the priorities of port administration, it behoves a port authority to provide suitable data showing the occurrence of high and low tides throughout the calendar year. These are published as tide tables and made available to the public interested in shipping. Nowadays the scientific calculations can be undertaken by tidal experts. Canada has a tidal investigation department of its own. Indian tide tables are prepared under the direction of the Director, Geodetic Branch, Survey of India. In Indian estuaries the freshets have a considerable influence and for the Hugli River the predictions of high and low water are deduced partly with the aid of the tide predicting machine at Dehra Dun, designed by Lord Kelvin—the levels modified to include the freshets in the river, which alter the normal levels and times considerably throughout several months of the year.

For the navigators of all nations, the British Admiralty publish in their Tide Tables comprehensive information for many seaports of the world, which form a useful guide to mariners.

Diagram Illustrating a Uniform System of Lateral Buoyage.



International Regulations

There is a proviso in the International Regulations for Preventing Collisions at Sea to the effect that "these Rules shall be followed by all vessels upon the high seas and in all waters connected therewith navigable by sea-going vessels." (Schedule 1, Preliminary) Art. 30 provides (Reservations of Rules for Harbours and Inland Navigation): "Nothing in these Rules shall interfere with the operation of a special rule duly made by a local authority, relative to the navigation of any harbour, river or inland waters."

The Public Right of Navigation

In the British Islands there exists a public right of navigation for individuals using the estuarial waters forming the approaches to seaports. This right implies free movement from place to place within the area, provided that the shipping, yachting, or boat dues are paid and the regulations affecting vessels are observed. It indicates that the water which floats vessels is not in the ownership of any local body, but of the state representing the people. This elementary right of navigation extends to international rivers which flow through several countries in their course to the sea. The Danube is one such river; the Rhine is another having claims to international interest of this character.

Bye-Laws

Navigation Bye-laws, Storm Warning Signals (in localities where hurricanes may occur); the control and guidance in respect of petroleum and other special cargoes; fishing limitations, etc., are matters for special local regulation. Collision Regulations and Bye-laws in the main derive their principles from those of the International Steering and Sailing Rules and are constructed so that a vessel coming in from sea is not required to switch over from one set of principles to another, but is guided by similar regulations conducting it to the docks through the narrow channels. In this connection, ferry steamers must at all times keep clear of vessels passing up and down the main river of the Port of London.

Priority in Navigation

In the Scheldt and Elbe, priority in the passage of large vessels is afforded by a special signal on tonnage and draft, by which steamships of lesser tonnage and draft are required to give right of passage to the larger ones.

The River Committee of the Port of London has examined the practicability of a priority signal giving special privileges to vessels of large tonnage in their navigation of the Thames Tideway, but notwithstanding the views of some river pilots, who favoured the idea and have the responsibility of handling large liners, the proposal has not been approved.

Conditions of navigation are different in the Thames compared with the Scheldt and Elbe. By dredging the channel of the Thames leading from the Nore Light Vessel to King George V. Dock, a distance of approximately 40 miles, the main course of the waterway has been canalised for 33 miles at 30 feet deep by 1,000 feet wide at L.W.O.S.T. and 7 miles at 30 to 27 feet deep by 600 feet wide at L.W.O.S.T. to a position where the King George Dock receives the largest vessels now using the seaport.

In the Scheldt and Elbe there are several cross and side channels of a type non-existent in the Thames, which permit vessels of lesser draught and tonnage to converge on the main stream of traffic at several points during the navigation from Flushing and Cuxhaven to the docks and upper reaches at Antwerp and Hamburg respectively. There is another important point of principle governing the refusal to favour a large vessel at the inconvenience of a smaller when navigating in a public waterway, namely, that one vessel—irrespective of size—has as much right under law as another to use the waterway.

Estuarial Management—continued

Notices to Mariners

Notices to Mariners are issued by Maritime Governments and by seaport authorities. The writer is unaware of any international or statutory obligation to do so, but the practice has grown and has been strengthened by the facilities afforded by wireless telegraphy. These Notices deal primarily with dangers to navigation, but may cover other warnings, such as the presence of dredgers in awkward situations, failure of lights on buoys which form the sea or river marks in the estuary, shoaling of channels which will eventually require to be deepened, and so forth.

Surveys and Charts

In waters where pilotage is compulsory, the seagoing navigator has less need to trouble about the changing conditions of width and depth which affect channels. Banks which change their situation and character are usually indicated on the charts of the approaches to seaports as normal aids to navigation. Several vessels have struck obstructions not marked on the charts due to the limits of the method of taking soundings by hand lead and line. The invention of the supersonic electrical impulse depth recorder—a development of the echo-sounder—has changed these conditions by providing more soundings than the hand lead method was capable of, and by introducing a radial search within the ambit of the impulse.

Where tides and currents run strongly and pinnacle rocks exist, there is a strong tendency when dropping a hand lead to measure the least depth on the summit of a submarine knoll or pinnacle rock to miss the apex due to the tide force splitting, and thus carrying the hand lead to one side where there is more depth. As an example, two cases can be quoted where surveys were regarded as reasonably complete: (1) The Tucker Rock in Torbay, Devon, which provides a homely illustration of the limitations of accuracy referred to. About the year 1907, when the British Fleet was proceeding to sea, the easternmost warship struck a rock not marked on the chart. Investigation by the normal methods failed to find the obstruction, when a local fisherman named Tucker volunteered to locate it with his trawl, having fished the area. Thus the Tucker Rock was located and its pinnacle plotted on the chart, having in previous surveys eluded the lead line. (2) In the narrows of St. John's Harbour, Newfoundland, and near the leading marks, will be found the Ellinor Rock, named after the survey ship which located it in 1911. Some years previously a vessel under pilotage struck this unmarked obstruction when the ship was off the leading marks, due to a snowstorm. An injustice was done to the pilot, as no proper examination was made at the time, and the case coming under the local Marine Board, the matter passed from the currency of action to the disadvantage of the pilot. When the rock was located in 1911, the pilot had passed away, convinced of the injustice. As an added injustice, a rock further inshore was dubbed " Pilot's Rock," and the pilot's name attached to it.

Meteorological Effects

Some of the South African estuaries on the East Coast afford striking examples of how rainfall, sudden and decisive, can wash away bars at the harbour mouth which have accumulated during the dry weather. Littoral drift consisting of material washed on to the foreshores from the cliffs and forelands tends to bank up at the mouth of rivers and the coastwise currents meet the river discharge laden with detritus from the uplands. This forms a dead-line which can only be removed by (a) periodical dredging; (b) sudden upland discharge of abnormal volume and velocity harnessed to suitably designed piers or river channel walls. This condition (b) is found at some South-East African estuaries. At some New Zealand harbours, notably Greymouth and Westport, there are more complex problems, in that the silt at the harbour entrance has marched seaward with the extension of the piers, so that the depths have not improved as desired. On the West Coast of New Zealand the persistent onset of the prevailing winds throws back the beach travel against the coastline and thus prevents dispersal over a wide apron of depth. Harbours so situated are therefore harnessed to two specific problems (1) the expense of continual engineering works and dredging; (2) arranging for vessels constructed with a special shallow draft to negotiate the bars in times of severe shoaling, and thus continue a valuable trade on an economic basis. In effect, this latter plan is adopted in the Thames by the collier trade, where up-river delivery points are essential to the organisation. The sea voyage in this case approximates 600 miles.

Dredging of Harbours and Rivers

We come to the conquest of man over matter, in its marine sense, in the dredging and deepening of harbours and rivers. This mechanical conquest, allied to hydrography, has enabled such ports as Liverpool, London, Southampton and New York, to receive the largest vessels ever built, approximating 1,000 feet in length, with drafts close on 40 feet. There are indications that the upward trend of tonnage is coming to rest at a level approximating the Cunarder, *Queen Elizabeth*. Without dredging, these tonnages could not have been accommodated.

The future dimensions of the aircraft carrier or warship cannot be forseen. For these ships, suitable harbours may not be within the control of commercial interests and need not concern us here, as the question would be one of national management.

The Turning Circle of Ships

When the civil engineer embarks upon the large-scale development of a tidal waterway by means of dredging, he requires the combined assistance of the naval architect and a navigator, the latter may best be the marine officer of the seaport or the marine superintendents of the steamship lines using the port.

It becomes necessary to consider the radius in which the larger vessels require to manœuvre, and consequently the radii of curves used in the channel development. The natural tendency for channels, be they of tidal or fresh water formation, is to create a series of deep pools on the concave sides of the water course, with shallows at intervening positions where the under-current passes over from one side of the stream to the other. In tidal rivers, the flood stream complicates the conditions. Under speed and helm the turning circle of a ship is greater than when tugs are employed ahead and astern. In still water a ship may be turned in her own length, whereas if a current is strong she may occupy a length and a half in the manœuvre. In turning vessels of great length, the time factor is also of importance and interest. An illustration can be given of a liner lying in the stream off the Isle of Wight with a tide running at 3 knots or more. This vessel, about 800 feet in length, required 30 minutes to turn 180° without the aid of tugs.

Financial Considerations

In estuarial management there are usually two major considerations of finance: the conservancy revenues and obligations in the forms of river dues and dredging respectively, and dock dues in the form of charges for the use of the docks. Revenues may be derived by conservators from the licensing of private piers and other works in the waterway. Expenses may be incurred by them in maintaining buoyage, lights, and a competent river service to manage these aids to navigation.

It is generally the duties of the conservators to safeguard the interests of the waterway under their charge in respect of pollution, of subterranean tunnelling which may affect the river bed, cross river bridges which may affect navigation, and the prevention of fire with the policing of the waterway.

The handling of dangerous cargoes needs special care and segregation; so that the commodity may form a part of the industrial prosperity of the seaport which, in its ultimate function, is an access to and egress of foreign trade.

North Ireland Harbour Bill.

The Expiring Laws Continuance Bill, recently presented in the Northern Ireland Parliament, includes the Harbour, Docks and Piers (Temporary Increase of Charges) Act, which was passed to enable public authorities and companies who carry on harbour, dock and pier undertakings to receive authority for increasing the charges made by them to the public without applying to Parliament for the necessary power.